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Environmental Development Plan

Defense Waste Management

September 1980

U.S. Department of Energy
Assistant Secretary for Nuclear Energy
Assistant Secretary for Environment

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FOREWORD

Environmental Development Plans (EDPs) are prepared by the Department of Energy (DOE) to help fulfill its responsibility for the development of environmentally acceptable energy technologies. The EDP serves as a basis for planning and reviewing the environmental progress of DOE's energy technology development programs.

Each EDP identifies the environmental concerns and research and development necessary to assess the potential environmental impacts and mitigating measures associated with an energy technology. Thus, to ensure that environmental, health, and safety (EH&S) considerations will be addressed adequately in the technology program decisionmaking process, the EDP (1) identifies and evaluates EH&S concerns; (2) defines EH&S related activities to examine or resolve the concerns; (3) provides a coordinated schedule with the technology program for required EH&S activities; and (4) indicates the timing for Environmental Impact Statements, Environmental Readiness Documents, and Safety Analysis Reports.

The Defense Waste Management Program (as well as the Commercial Waste Management Program) is in itself directed to the resolution of EH&S concerns or issues. In many instances the program activity is the means by which these concerns are to be mitigated.

The EDP for Defense Waste Management was prepared jointly by the Office of Nuclear Waste Management, under the Assistant Secretary for Nuclear Energy, and the Technology Assessments Division (with assistance from the research and support divisions) under the Assistant Secretary for Environment.

This Environmental Development Plan on Defense Waste Management is being released under authority of DOE Order 5420.1, dated August 10, 1978. When necessitated by progress or revisions in programs, Environmental Development Plans are updated and reissued. Everyone having pertinent interests and responsibilities is invited to review this Environmental Development Plan and suggest changes for future updates.

Ruth C. Clusen

Ruth C. Clusen
Assistant Secretary for
Environment

George W. Cunningham
Assistant Secretary for Nuclear
Energy

PREFACE

This Environmental Development Plan serves as a basis for planning and reviewing the environmental progress of the Department of Energy's program for the management of radioactive wastes generated by its defense activities.

Coordination of the implementation and maintenance of this Environmental Development Plan (EDP) on behalf of the Assistant Secretary for Nuclear Energy is a function of the Office of the Deputy Assistant Secretary for Nuclear Waste Management Programs (OWM). Dr. Randal S. Scott is the OWM contact for this EDP.

The Technology Assessments Division (TAD) of the Office of Environmental Assessments is responsible for the day-to-day coordination of this EDP on behalf of the Assistant Secretary for Environment. Dr. Jerry J. Swift is the TAD contact for this EDP.

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ABBREVIATIONS

AD	Director of Administration
ANL	Argonne National Laboratory
ASDP	Assistant Secretary for Defense Programs
ASEV	Assistant Secretary for Environment
ASNE	Assistant Secretary for Nuclear Energy
BCT	Best Control Technology
BMI	Battelle Memorial Institute
CFR	Code of Federal Regulations
CWM	Commercial Waste Management Program
DEIS	Draft Environmental Impact Statement
DOE	Department of Energy
DOI	Department of Interior
DOT	Department of Transportation
EA	Environmental Assessment
ECC	Environmental Coordinating Committee
EDP	Environmental Development Plan
EGG	Edgerton, Germeshausen and Grier Corporation
EH&S	Environmental, Health and Safety
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ER	Environmental Report
ESE	Environmental and Safety Engineering Division, ASEV
EV	Organizational Units Reporting to the Assistant Secretary for Environment
FEIS	Final Environmental Impact Statement
FSAR	Final Safety Analysis Report
GEIS	Generic Environmental Impact Statement
GSA	General Services Administration
HLW	High-Level Waste
ILW	Intermediate-Level Waste
INEL	Idaho National Engineering Laboratory

ABBREVIATIONS (Cont.)

IRG	Interagency Review Group
LASL	Los Alamos Scientific Laboratory
LLL	Lawrence Livermore Laboratory
LLW	Low-Level Waste
LWR	Lightwater Reactor
MTU	Metric Tons of Uranium
NAC	Nuclear Assurance Corp.
NAD	NEPA Affairs Division, ASEV
NAS	National Academy of Sciences
NEPA	National Environmental Policy Act
NIEHS	National Institute of Environmental Health & Safety
NIOSH	National Institute of Occupational Safety & Health
NRC	Nuclear Regulatory Commission
NTS	Nevada Test Site
NUS	Nuclear Utilities Services Corporation
OCA	Office of Consumer Affairs
OCFM	Office of Construction and Facility Management, AD
OEA	Office of Environmental Assessments, ASEV
OES	Operational and Environmental Safety Division, ASEV
OHER	Office of Health and Environmental Research, ASEV
OIA	Office of Intergovernmental Affairs
ONWI	Office of Nuclear Waste Isolation, BMI
OPA	Office of Public Affairs
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Act
OSS	Office of Safeguards and Security, ASDP
OWM	Office of Nuclear Waste Management, ASNE
PEIS	Programmatic Environmental Impact Statement
PNL	Battelle Pacific Northwest Laboratory
PSAR	Preliminary Safety Analysis Report
R&D	Research and Development
RL	Richland Operations Office and Hanford Site
SCP	Site Characterization Plan

ABBREVIATIONS (Cont.)

SCR	Site Characterization Report
SLB	Shallow Land Burial
SNM	Special Nuclear Material
SRL	Savannah River Laboratory
SRP	Savannah River Plant
TAD	Technology Assessments Division, ASEV
TLV	Threshold Limit Value
TRU	Transuranic
TWTF	TRU Waste Treatment Facility
TVA	Tennessee Valley Authority
WIPP	Waste Isolation Pilot Plant

ABBREVIATIONS (CONT'D)

IRG	Interagency Review Group
LASL	Los Alamos Scientific Laboratory
LLL	Lawrence Livermore Laboratory
LLW	Low-Level Waste
LWR	Lightwater Reactor
MTG	Matrix Technology [illegible]
NAC	Nuclear Assurance Corp.
NAD	NEPA Affairs Division, ASEV
NAS	National Academy of Sciences
NEPA	National Environmental Policy Act
NIEHS	National Institute of Environmental Health Sciences
NIOSH	National Institute of Occupational Safety & Health
NRC	Nuclear Regulatory Commission
NTS	Nevada Test Site
NUS	Nuclear Utilities Services Corporation
OCA	Office of Consumer Affairs
OCFM	Office of Construction and Facilities Management, MA
OEA	Office of Environmental Assessments, ASEV
OES	Operational and Environmental Safety Division, ASEV
OHER	Office of Health and Environmental Research, ASEV
OIA	Office of Intergovernmental Affairs
ONWI	Office of Nuclear Waste Isolation, BMI
OPA	Office of Public Affairs
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Act
OSS	Office of Safeguards and Security, ASDP
NWM	Office of Nuclear Waste Management, ASNE
PEIS	Programmatic Environmental Impact Statement
PNL	Battelle Pacific Northwest Laboratory
PSAR	Preliminary Safety Analysis Report
R&D	Research and Development
RL	Richland Operations Office and Hanford Site
SCP	Site Characterization Plan

I. SUMMARY

This Environmental Development Plan (EDP) identifies the planning and management requirements and schedules needed to evaluate and assess the environmental, health and safety (EH&S) aspects of the Defense Waste Management Program (DWM). Environment is defined in its broadest sense to include environmental, health (occupational and public), safety, socioeconomic, legal and institutional aspects.

A. Scope

This plan encompasses the programmatic and environmental, health and safety considerations associated with the handling of DOE wastes generated primarily as a byproduct of the DOE national defense programs. The Defense Waste Management Program and the Commercial Waste Management (CWM) Program deal with similar technologies pertaining to waste processing, immobilization, packaging, burial, and disposal. However, commercial waste activities are addressed in a separate EDP and are considered in this EDP to the extent that such activities are common to the Defense Waste Management Program. This plan does not address mining and milling tails, transportation of wastes, decommissioning and decontamination (D&D) programs or safeguards, security and proliferation aspects.* This EDP is consistent with the Report to the President by the Interagency Review Group on Nuclear Waste Management, dated March 1979, and President Carter's Statement to the Congress on Radioactive Waste Management, February 12, 1980.

B. Technology Program

The DWM Program is structured into two major areas of activities: Interim Waste Management Operations and Long-Term Waste Management Technology. These program activities deal with the planning, surveillance, handling, treatment and storage, and disposal of radioactive wastes generated primarily as a result of programs to produce nuclear materials in weapons and other national defense activities. Radioactive wastes include high-level wastes (liquid and solid), low-level wastes, transuranic wastes and airborne (gaseous) wastes. The ultimate objective of the technology program is to isolate existing and future nuclear wastes from the biosphere (with minimal long-term dependence on institutional controls) so that they pose no significant threat to public health and safety.

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*EDPs on related topics are: Environmental Development Plan for LWR Commercial Waste Management (July 1980), Environmental Development Plan for Uranium Mining, Milling and Conversion (August 1979), Environmental Development Plan for Decontamination and Decommissioning (July 1979), Environmental Development Plan for DOE Nuclear Materials Transportation (in draft), Environmental Development Plan for Low Level Waste Management (in preparation).

The Interim Waste Management Program provides for the operation, surveillance, and maintenance of facilities to handle, process (as appropriate), store, and dispose of high-level, low-level, gaseous, and transuranic wastes in a manner compatible with the alternatives for long-term waste management. The existing 10 million cubic feet (75 million gallons) of HLW in the form of liquid, salt cake, sludge and calcine is maintained in underground tanks and bins. The 51.9 million cubic feet of solid low-level wastes and 9 million cubic feet of TRU waste have been placed in shallow land burial. Currently generated TRU wastes (1.9 million cubic feet) have been stored since 1970 in a 20-year retrievable mode. The major interim waste management efforts will provide for improved HLW tanks and facilities (completed by 1982), continued retrievable storage for existing and future generated TRU wastes, and the stabilization of existing burial grounds for LLW (FY1987). The Long-Term Waste Management Technology effort is projected to result in the selection at all sites of processes for HLW treatment and immobilization for disposal, with construction of the HLW treatment facility at SRP beginning in FY1983 and the initial operation (Idaho National Engineering Laboratory, INEL) of the Transuranic Waste Treatment Facility (TWTF) in FY 1989. The Waste Isolation Pilot Plant (WIPP), previously designated as the repository for defense TRU waste, has been cancelled by President Carter. Congress has refused to accept the rescission of the WIPP project. Work toward further qualification and development of the site is proceeding.

C. Key Environmental, Health and Safety Concerns and Requirements

The EH&S concerns in this EDP include only those directly relevant to the Defense Waste Management Program. Generic concerns, such as biological effects of low-level radiation exposures, are to be addressed in a generic nuclear concerns and requirements document.

The major specific EH&S concerns are related to the effectiveness of waste management systems in isolating these wastes from the environment in order to minimize the risk of radiation exposure to workers, the public and ecosystems. This is reflected in the concerns for 1) maintenance and surveillance of HLW in interim storage tanks which requires an early decision and implementation of the preferred long-term waste treatment option; 2) disposition of high-level waste after treatment (if the treatment option is exercised) to place the waste in a more acceptable form for long-term isolation; 3) shallow land burial of solid LLW which requires development and evaluation and issuance of standard operating criteria, development of improved packaging, volume reduction, residue stabilization, and stabilization of sites no longer in use; 4) the inventory of radionuclides in the soils and sediments primarily at the chemical reprocessing sites which requires continued surveillance and the development of improved techniques for surveillance; 5) EH&S risks of exhuming buried transuranic (TRU) wastes which will require a cost/benefit and environmental analysis; (6) EH&S risks of stored and buried TRU wastes which may require the development of TRU waste treatment technology to meet repository acceptance criteria and a repository to provide terminal isolation; and 7) EH&S penalties for delays in meeting planned schedules due to non-programmatic reasons (institutional, public and political considerations) which require continued effort to coincide with the technical and National Environmental Policy Act (NEPA) plans.

D. Key Environmental Planning Elements

The key environmental planning elements are 1) those activities required to meet or mitigate the EH&S concerns identified in Table III-1 and correlated in time to meet need dates for the major milestones for interim, long-term and terminal storage activities, and 2) identifying and implementing NEPA requirements. The Office of Nuclear Waste Management is currently developing a Waste Management NEPA Plan which will address the NEPA requirements and activities for the Defense Waste Management Program as well as other waste management programs in the OWM. The data provided in Table III-1 and Figures IV-1 through IV-5 show that programs are in place or planned which will resolve the majority of concerns commensurate with programmatic milestone.

Decisions are scheduled to be made on the selection of long-term waste management alternatives for the treatment of HLW located at the Idaho National Engineering Laboratory (INEL), Idaho, Richland (RL), Washington, and the Savannah River Plant (SRP), South Carolina. Schedules have not been identified for decisions on the disposition, long-term storage or terminal isolation of treated HLW. Whether or not the WIPP project will continue must be settled. These considerations become significant because the absence of decisions and plans influences the identification and significance of EH&S concerns. Technology and facility development planning milestones have been the driving elements of the program projections, and as appropriate the NEPA and other EH&S activities have been dovetailed accordingly. However, uncertainties of institutional and public involvement and political considerations have not been factored into the EDP except to the extent allowed to meet regulations and licensing requirements, if applicable. Should such elements be introduced to the point of delaying critical parts of the technology and environmental program schedules and plan, the EH&S concerns and corresponding risks would be extended.

II. TECHNOLOGY PROGRAM

A. Program Scope and Goals

The Deputy Assistant Secretary for Nuclear Waste Management, reporting to the Assistant Secretary for Nuclear Energy, is responsible for the Defense Waste Management Program. The Director, Office of Waste Operations and Technology, has the responsibility for implementation and execution of the Interim Waste Storage Operations and the Long-Term Waste Management Technology Program addressed in this EDP.

The Defense Waste Management (DWM) Program deals with the radioactive waste material generated in support of the U.S. nuclear defense activities and DOE research and development program activities. It includes treatment, interim storage operations, and research and development activities focusing on long-term treatment for terminal isolation. The management of the program consists of planning, execution and surveillance of essential functions related to safe and effective control, and storage of the radioactive waste.

The waste material includes High-Level (HLW), Transuranic (TRU) Waste and Low-Level Waste (LLW). High-level wastes are irradiated spent nuclear fuel, liquid wastes resulting from the operation of the first cycle solvent extraction system and the concentrated wastes from the subsequent extraction cycles or equivalent in a facility for reprocessing irradiated fuel and solids into which such wastes have been converted. TRU wastes are materials containing more than 10 nanocuries of alpha activity from transuranic elements (elements with atomic number greater than 92, principally plutonium) per gram of waste (10 nCi/g). TRU wastes result predominantly from chemically processing irradiated fuel and target material and from plutonium handling and utilization (predominantly for nuclear weapons). LLW which contains less than 10 nanocuries of transuranic contaminants per gram of material may require little or no shielding but contain low, potentially hazardous concentrations of radionuclides. Low-level wastes are generated in all phases of the defense nuclear operations at various locations. The principal generators of waste in support of the defense program are the sites at Idaho Falls, Idaho; Hanford, Washington; Aiken, South Carolina; Rocky Flats, Colorado; and Los Alamos, New Mexico. Other sites generating wastes are at Oak Ridge, Tennessee; Fernald, Ohio; Mound Laboratory at Miamisburg, Ohio: KAPL, Schenectady, N.Y.; Bettis, Pittsburgh, Pa.; Sandia, Albuquerque, N.M.; Lawrence Livermore Laboratory, Livermore, Cal.; the Nevada Test Site; Portsmouth, Ohio; and Paducah, Kentucky. The DWM program also includes development of improvements in monitoring and cleaning airborne waste streams; radioactive wastes removed from ventilation and other airstreams become LLW or TRU waste.

The existing inventories (April 1979) of defense wastes are shown below:

Material Type	Quantity
HLW	10,000,000 cubic feet (75 million gallons)
TRU Waste	10,900,000 cubic feet
LLW	51,900,00 cubic feet

The overall objective of the DWM program is to isolate existing and future nuclear wastes from the biosphere so that they pose no significant threat to public health and safety. Specific objectives are to:

- Provide safe handling and interim storage of HLW and TRU waste, pending its long-term disposition, in a manner compatible with the several alternatives for long-term management presently under consideration.
- Dispose of liquid intermediate-level waste and LLW by techniques that minimize the potential for release of radioactivity to the environment and minimize required maintenance and surveillance.
- Evaluate and develop HLW treatment technologies to prepare these wastes for acceptance at permanent repositories and construct appropriate treatment facilities.
- Evaluate alternatives for long-term management of TRU wastes and construct appropriate treatment facilities to prepare these wastes for disposal.
- Provide long-term planning and advanced technologies for LLW disposal sites.
- Improve the efficiency and economy of processes to capture, treat, and dispose of airborne waste.

B. Program Elements

1. Interim Waste Operations

1.1 High-Level Waste

Idaho National Engineering Laboratory (INEL)

High-level waste is generated from the Idaho Chemical Processing Plant (ICPP) operations which recover uranium from irradiated high-enriched fuel from research reactors, naval propulsion and other reactors. The resultant acidic high-level liquid waste (nominal inventory of about 1.5 million gallons) is stored for one to three years in a system of eleven stainless steel tanks, each within an underground concrete vault (providing for decay of shorter lived fission products). The liquid waste is then transferred to the Waste Calcining Facility (WCF), which uses a fluidized-bed calcination process to convert it to a granular oxide solid. The solidified waste is transferred pneumatically to buried closed stainless steel bins within concrete vaults (current inventory is about 50,000 ft ^{3}). All bins except the oldest set have provisions for installation of pneumatic unloading equipment.

Generation of calcined waste is projected to continue at a rate of about 5000 ft^3 per year until 1982; a new calciner is expected to be in operation early in 1982. The new WCF is estimated to generate about 16,000 ft^3 of solid waste per year; it will be operated continuously (with the reprocessing plant) to take care of expected higher throughput of spent fuel; and it will have a number of design changes providing for remote maintenance of key equipment, thus reducing occupational radiation exposures and promoting continuity of operation. This high-level waste management system provides a relatively quick reduction in unit volume of waste and a form less mobile than liquid form but compatible with easy transfer, and long-term storage/disposal option forms.

Hanford Site (Richland, Washington)

High-level defense waste has been generated at Hanford over a number of years as a result of operating several chemical processing plants. There are no currently operating processing plants. The Purex Plant, which is capable of processing irradiated natural uranium or slightly enriched uranium fuel to recover plutonium, neptunium, and uranium, is now on standby status. If the decision is made to reprocess the Hanford N Reactor fuel (the only production reactor remaining in operation at Hanford) the option is to operate the Purex Plant as required by the accumulation of spent fuel. Four other chemical processing plants at Hanford are no longer processing irradiated fuel and have been retired from these activities. However, these plants, or parts of them, may still be used for nuclear-related purposes such as waste treatment or equipment decontamination.

High-level liquid wastes (currently about 53 million gallons of which 90% is in solid form) generated since 1945 by the processing plants have been transferred by underground pipelines to large underground tanks. To date, waste has been transferred to 156 tanks; an additional 13 tanks are under construction. During the period 1943 to 1964, 149 tanks of a single shell (SS) design were constructed, ranging in size from 55,000 to 1,000,000 gallons. The other 7 tanks built since 1968 plus the 13 tanks under construction are of a double shell (DS) design with a capacity of 1,000,000 gallons each. Of the 149 SS tanks, 24 are confirmed leakers and another 34 are of questionable integrity.

Over the years a number of operations have been performed upon these wastes which have required their removal and transfer. In the early 1950's, dense uranium-bearing sludge was sluiced from tank bottoms, blended with supernate, acidified, and transferred to a converted reprocessing plant where the uranium was recovered and the resulting waste returned to storage. Another major operation, begun in the mid-1960's, is the In-Tank Solidification (ITS) program which concentrates waste solutions to the point where they will flow as liquids only at an elevated temperature. Upon cooling, the material forms a damp salt cake in the underground tanks. For a portion of the Hanford wastes, most of the heat-producing ^{90}Sr and ^{137}Cs was chemically separated from the waste solutions in a converted reprocessing plant prior to solidification; these nuclides were then solidified, encapsulated, and stored in an adjacent facility.

The original waste tank design (SS) used a single carbon steel liner (single shell tank) within a reinforced concrete tank. In the 24 cases where these tanks have leaked, monitoring has shown that the radioactivity was absorbed in the soil near or beneath the tanks, and that none has reached the ground water 200 to 250 feet below the tanks' bottoms. Nevertheless, the leaks have been followed by reports of considerable criticism and expressions of concern in the news media.

Since 1968, an improved double shell (DS) design has been used for all new tank construction at Hanford. The DS design consists basically of two complete concentric carbon steel tanks within the reinforced concrete tank with provisions for monitoring and removing any leakage into the annular space between the tanks. There have been no instances of liquid escaping into the soil from tanks of this newer design.

The Intank Solidification (ITS) Program uses the older single-walled tanks only for storage of bulk sludges or salt cakes in order to reduce the mobility of the contained material. Existing evaporators in retired reprocessing plants and two new vacuum crystallizers have been used in this evaporation-crystallization process. On completion of the current ITS effort, the inventory of liquid waste in the Hanford tank areas will be a relatively constant inventory of fresh high-level liquid waste undergoing cooling if reprocessing occurs (decay of short-lived isotopes), and a relatively small amount of about 1,000,000 gallons of drainable residual liquor still left in the single shell tanks from the ITS process. (Research and development efforts may result in the reduction of the amount of residual liquor by one-half). The double shell tanks will be used for storage of "pumpable" liquids and new waste. There will be large volumes of damp salt cake stored in bulk in tanks. The cesium and strontium removed from the waste prior to conversion to a salt cake are concentrated, solidified, encapsulated, and stored as a solid in a water-cooled basin.

Savannah River Plant

Two chemical separation facilities (commonly called "spent fuel reprocessing plants") at the Savannah River Plant, along with auxiliary facilities, are in operation to recover Pu-239, uranium and tritium for the nuclear weapons program and some radionuclides for nonweapons use. The high-level liquid waste, after storage for cooling, is evaporated to produce a damp, bulk salt cake (over a layer of sludge) in the tanks. The current inventory of about 20 million gallons of solid and liquid waste is expected to be maintained with a decreasing ratio of liquid to solid waste. Up to 33 tanks (750,000 - 1,300,000 gallons) have been in use at SRP with an additional 18 tanks in various stages of availability. SRP has constructed only 8 single-walled tanks; all others are double-walled or cup and saucer types. Leakage of radioactive material to the soil has occurred in two instances.

1.2 Low-Level Waste

Low-level radioactive wastes (LLW) consist of a variety of radioactively contaminated solids that, because of the nature (relatively short-lived radioisotopes) and relatively low level of radioactivity in the bulk of the wastes, can be disposed of safely in shallow pits or trenches. For some LLW the level of radioactivity involved is so low that no special biological shielding is required to protect personnel from radiation exposure. (Some low-level wastes and transuranic wastes have radioactivity levels so low that it has been impractical to measure them and they have been designated radioactive wastes because they are "suspect".) These wastes, including paper, trash, clothing, broken glassware, plastic tubing, radioactive animal carcasses, etc., are packaged in plastic bags, metal cans, and cardboard boxes. Other LLW, including resins, filters, sludges, piping, shielding, control rods, etc., contain sufficient quantities of radioactivity so that shielding and/or remote handling techniques are required to protect personnel from radiation exposure. These wastes are packaged in metal, specially treated wood boxes, or concrete containers. In order to reduce the volumes of low-level solid waste that must be disposed of, various volume reduction techniques (including compaction and incineration) are currently in use at LASL, INEL, Hanford and NTS.

As of April 1979, the total inventory of LLW was about 51.9 million ft^3. In 1978, DOE and its contractors generated approximately 1.8 million ft^3 of LLW containing about 1 million curies of radioactivity for disposal at DOE burial grounds. (Another 0.5 million ft^3 of DOE generated LLW, containing about 0.5 million curies, were shipped to commercially operated burial sites.)(1) The annual generating rate is expected to be about 1.9 million ft^3.

Most of the LLW generated by DOE and its contractors is disposed of at six DOE operated burial sites: the Los Alamos Scientific Laboratory (LASL), the Idaho National Engineering Laboratory (INEL), the Hanford Reservation, the Nevada Test Site, the Oak Ridge National Laboratory and the Savannah River Plant.

Waste disposal operations consist of placing or dumping waste packages into pits and trenches and covering the waste with soil. The width, depth, and length of disposal trenches vary with each site. Trench dimensions are primarily dependent on the geologic formation, the type of equipment used, the configuration of the waste, the local hydrologic conditions and the suitable land area available. Trenches range from 1.5 - 4.5 m wide, from 2 - 11 m deep, and from 6 - 300 m long. For intermediate and higher activity waste, a narrow trench is usually used because the trench walls provide a considerable amount of shielding. Because of the differences in the size of trenches, the spacing between trenches, and the packing of waste within trenches, the burial densities at the various DOE sites are different. They range from 68,000 ft^3/acre at Hanford to 200,000 ft^3/acre at Los Alamos.

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1. DOE recently announced that all of the LLW generated within its programs would be shipped to DOE sites.

Although the disposal of LLW at shallow land burial sites has in some instances resulted in the release of radionuclides to the environment, these releases have not resulted in any significant impact on the public health and safety. Nevertheless, DOE is committed to improving the effectiveness of LLW disposal both at the currently operating DOE burial sites as well as the inactive areas. These improvements are sought in the technical area with the development of more effective volume reduction, waste immobilization, and disposal techniques and with the development of burial ground stabilization technology. Improvements are sought through the development of waste preparation requirements, site selection and site operation procedures and waste disposal criteria. DOE final burial ground operating criteria are scheduled to be issued in 1981 with a goal of all sites being in compliance by 1987.

1.3 Transuranic Waste (TRU)

TRU wastes have been produced predominantly at the Hanford, Savannah River, Los Alamos, and Rocky Flats sites. Since the 1940's, materials contaminated with transuranics have been placed in near surface burial grounds. Current practice (post-1970) is to store TRU-contaminated waste greater than 10 nCi/gm in a readily accessible manner so it will remain readily retrievable for a minimum of 20 years. These stored wastes will ultimately be retrieved, processed as necessary, and sent to a disposal facility, once such a capability is available.

The inventory of TRU waste as of April 1979 was about 10.9 million ft^3 with 9 million ft^3 buried and 1.9 million ft^3 in retrievable storage. The annual rate of generation is estimated to be about 0.2 million ft^3. The major burial grounds for TRU wastes are at the Hanford, Savannah River, Idaho National Engineering Laboratory and Los Alamos Scientific Laboratory sites.

The TRU waste at the Idaho Falls site was generated primarily at the Rocky Flats site near Denver, Colorado, then shipped to Idaho Falls. Prior to 1970 this material was buried in pits but to permit its retrieval is now arranged in modular cells stacked on asphalt pads, covered with plywood and waterproofed liners, and covered with earth. The cells are continuously monitored.

The TRU waste at the Hanford site has been generated primarily on site, although some material has been received from other sites, such as Rocky Flats. Since 1970 the TRU waste at Hanford has been segregated in special sealed containers and stored in shallow lined trenches so that it is readily retrievable. Large bulky equipment is stored in the railroad tunnel extending from the Purex plant. Prior to that time, a substantial amount of the TRU waste was buried in trenches and is not readily retrievable.

The TRU waste at Savannah River is stored in a central area, protected from contact with water-saturated soil. Polyethylene-lined galvanized drums are used as the primary container and are stored on a concrete pad and covered with 4 feet of earth. Bulky equipment is stored in earthen trenches.

Techniques are under development to remove the waste from retrievable storage and to treat them if necessary to meet disposal criteria. Techniques and requirements for recovery and treatment of previously buried TRU wastes at INEL are being developed, pending a decision in FY1981 to exhume these INEL buried wastes for disposal by different technology or to stabilize these materials in place for terminal disposition.

1.4 Intermediate Level Waste

Oak Ridge National Laboratory (ORNL)

DOE Research and Development programs at ORNL generate liquid radioactive wastes (classified by ORNL as intermediate liquid waste). Such wastes produced at other sites are concentrated and treated with the high-level waste inventory or decontaminated and the residues treated with the low-level waste. The

ORNL wastes are treated or evaporated at a central area. This area also has six underground "gunite" tanks which hold strontium- and cesium-bearing dense sludges resulting from the early ORNL operations.

Shale fracturing has been used at ORNL since the mid-1960's to dispose of these ORNL wastes. This technique involves the use of hydraulic pressure to produce broad void spaces deep underground by fracturing the shale formation. Liquid radioactive wastes, mixed with grout-forming materials, are pumped into the voids resulting in a series of layers of waste set in concrete within the shale. Since the shale is extremely impermeable, it is felt that the desired long-term isolation is provided. The practical limitation on activity levels of waste disposed of in this manner is now set by occupational exposure considerations at the surface facilities. Present plans are to provide a new well near the original site with improved shielding and remote operating capability for surface piping, pumps, and valving. The new facility could accommodate the old gunite tank sludges, blended in with current wastes. A safe, workable system will have to be developed for retrieval and disposal of these sludges by hydrofracturing.

2. Long-Term Waste Management Technology

This program provides for technology development, engineering studies, conceptual designs, tests and demonstrations and evaluations as a base for selecting site-specific alternatives for long-term isolation.

2.1 High-Level Waste

Three basic alternatives have been identified to provide the isolation of generated high-level wastes from man:

- Retrieve waste from interim storage facilities, process to a stable form, package and dispose on-site in surface or geologic facilities.

- Retrieve, process and package as in the first alternative and dispose off-site in the option chosen for terminal isolation (e.g., geologic repository).
- Continue ongoing practices indefinitely with evolutionary improvements leading to stabilization for terminal isolation (disposal).

The R&D program under way and projected does not foreclose any of the alternatives. The second alternative has been selected as the reference program. Alternative waste forms include glasses, artificial minerals, concretes, calcines, ceramics and matrices such as calcine particles in a metal base. Acceptable physical and chemical properties for these forms are being evaluated as well as expected release rates in fabrication, shipment and storage. Each of the three HLW storage sites is developing technology for the retrieval and processing of site-specific wastes. A reference process has been recommended at SRP and a Savannah River Defense Waste Processing Facility (DWPF) is proposed to be in operation in FY1990. Repository acceptance criteria and standards will be satisfied as well as all state and local laws for waste shipped to a Federal repository.

2.2 Low-Level Waste

A multi-laboratory program is under way to improve the scientific basis for disposal methods and to develop disposal criteria. Disposal site selection criteria, site operating practices, waste preparation requirements and system optimization studies are being developed.

Burial ground stabilization technology is being developed, and R&D on improved characterization of geohydrological environments and on the migration behavior of wastes is under way. These efforts will form the basis of stabilization requirements for each burial site.

2.3 Transuranic Waste

2.3.1 Technology

The routine disposal of TRU solid waste at DOE sites by shallow land burial was terminated in 1970. Since 1970 TRU wastes have been placed in 20-year retrievable storage. New technology and capabilities need to be developed for the safe handling, processing and packaging for the disposal of TRU waste. Ongoing development work is directed to previously buried waste, retrievably stored waste, and future generated wastes. Some previously buried waste may require exhumation; therefore, each burial site location for TRU waste or TRU contaminated soil will be evaluated.

TRU waste technology is being developed for volume reduction by means of incineration of combustible waste, smelting, and removal of contamination from metal surfaces by electropolishing. Alternatives for the immobilization of the residuals in various waste matrices, such as polymers, concrete, metals, and glass, are being developed.

Facility requirements for processing and packaging retrievably stored TRU waste for geologic disposal are being determined. Centralized and decentralized facilities will be evaluated. These requirements will be influenced in large measure by the evolving acceptance criteria of the disposal facility and the transportation requirements.

Studies are being conducted to analyze the long-term environmental behavior of currently buried waste and to evaluate alternatives for exhumation as well as stabilization in place.

2.3.2 Transuranic Waste Treatment Facility (TWTF)

No large-scale TRU waste processing is under way in the U.S. This proposed project (slagging pyrolysis incinerator) will provide for the processing (planned for 1989) of stored and buried (as appropriate) TRU wastes at INEL. After processing, the waste form will be packaged and stored until transported to a Federal repository. Research and development in support of this project includes incineration studies, off-gas treatment, waste handling equipment, instrumentation systems, slag analysis, migration studies, remote operating equipment and systems, and regulatory requirements studies.

2.4 Airborne Waste R&D

This R&D is expected to increase the service life and reliability of filters and to improve the technology for collection and fixation of gaseous radionuclides in anticipation of regulatory requirements for the reduction of airborne radioactive releases from defense facilities. The primary effect is to make cost-effective improvements, enhance quality assurance, and provide new capabilities. R&D is under way to make cost-effective improvements, enhance quality assurance, and provide new technology as follows:

- Increase the service life of filters.
- Develop pre-filters to capture particulates near their source.
- Provide waste form and related processes to immobilize iodine-129, krypton-85, carbon-14, and tritium for storage.
- Develop technology to remove tritium from air and water.
- Develop real time monitoring systems for iodine-129, krypton-85, tritium, and carbon-14.

3. Terminal Storage (Long-Term Isolation)

At this time there is no defense waste management program effort identified directly in support of long-term isolation for defense high-level and TRU wastes. The Waste Isolation Pilot Plant (WIPP) served the objective of providing a deep geologic repository for the disposal of TRU wastes. The President has decided that the WIPP project at the Los Medanos site near Carlsbad, New Mexico, should be canceled and that defense wastes previously intended for disposal in the WIPP facility will be placed instead in a licensed commercial waste disposal facility. However, Congress has refused to accept the rescission of the WIPP facility. The use of WIPP as originally authorized may still be an option but it is likely that TRU wastes will go to a licensed commercial repository. The terminal disposition environment for the treated HLW, such as the product from the Savannah River Waste Treatment Facility, and the exhumed and stored TRU contaminated wastes is uncertain.

4. Milestones

Table II-1 summarizes the significant milestones for the Defense Waste Management Program. (These milestones are subject to change by the planning and budgeting processes.)

Table II-1

SIGNIFICANT MILESTONES

		Fiscal Year (except as shown)
1.0	**Interim Waste Operations**	
1.1	Complete Construction of New Waste Calcining Facility at ID	July 1980
1.2	All 149 Old Single-Shell Tanks Deactivated at RL (removed from liquid service)	1Q 1981
1.3	Begin Hot Operations of the New Waste Calcining Facility	2Q 1982
1.4	Complete Construction at SRP of all 18 New Tanks Needed for Tank Replacement	4Q 1981
1.5	Complete Construction of New Hydrofracture Facility at OR	1Q 1982
1.6	Complete Gunite Tank Sludge Disposal at OR	4Q 1983
1.7	All 149 Old Single-Shell Tanks at RL Interim Stabilized and Isolated	4Q 1985
1.8	Complete Burial Ground Upgrading to Meet DOE Final Criteria	4Q 1987
1.9	Complete Program to Remove HLW from 23 Old Tanks and Transfer to 18 New Tanks at SRP	2Q 1988
2.0	**Long-Term Waste Management Technology**	
2.1	Airborne Waste	
	Complete C-14 and H-3 Immobilization Technology	4Q 1982
	Double Life of First Stage and Glovebox Filters	4Q 1983
2.2	High-Level Waste	
	Issue Draft PEIS for INEL HLW	3Q 1980
	Issue Draft PEIS for RL HLW to Public	3Q 1981
	Complete Screening and Selection of Alternative Waste Form for SR Process and Issue Report	1Q 1984

Select Alternative Waste Form(s) for further Engineering Development	2Q 1984
Issue Draft Project-Specific EIS for INEL HLW Processing Facility	2Q 1991

2.3 Defense Waste Processing Facility

SR Submit Draft Project-Specific EIS	March 1981
SR Submit Preliminary Safety Analysis	September 1980
Issue Draft Project-Specific EIS for SR HLW	May 1981
Initiate Construction	2Q 1983
Complete Construction	1Q 1989

2.4 Low-Level Waste

Issue Final DOE Operating Criteria	September 1980
Issue Final Reports on Improved SLB Technology Field Tests at ORNL and LASL	4Q 1982
Issue Final Report on Demonstration of Intermediate-Depth Disposal	4Q 1983
Issue Final Report on Demonstration of Advanced Treatment Technology	3Q 1985

2.5 Transuranic Waste

Issued Draft PEIS on Buried TRU Waste	March 1980
Provide Basis for Policy Decision on INEL Buried TRU Waste	2Q 1981
Complete NEPA Documentation for Stored and Buried TRU Waste at All TRU Sites	3Q 1984
WIPP Site Acceptability Verification	1Q 1983
WIPP Underground Development	2Q 1983
WIPP Site & Design Verification	4Q 1983

2.6 Transuranic Waste Treatment Facility (INEL)*

Completed Conceptual Design on TWTF	March 1980
Draft Project-Specific EIS	September 1980
Complete Title I Design of TWTF	4Q 1981
Complete Project-Specific EIS	4Q 1981
Complete Startup and Initiate Testing on Reedy Creek Demonstration Plant	1Q 1982
Complete Title II Design	4Q 1984
Complete Construction of TWTF	3Q 1988
Start Production Operations at TWTF	4Q 1989

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*Dates for TWTF may slip from 1-2 years

III. ENVIRONMENTAL, HEALTH AND SAFETY CONCERNS AND REQUIREMENTS

A. Introduction

The objective of the Defense Waste Management Program is to isolate existing and future nuclear wastes from the biosphere so that they pose no significant threat to public health and safety. This is to be accomplished through interim storage activities and development and implementation of long-term storage modes for all forms of radioactive waste. Considering the goals of the program and the implementing activities, the entire waste management program by its very nature can be considered an environmental, health and safety program.

The dominant concerns of the waste management activities have continually focused on potential radiation exposure risks to workers, the public and the ecosystem in the event that accidental leakage and transport of radioactivity to the environment or uncontrolled access and exposure to the defense wastes should occur. This is evident by the historical evolution of the program. These concerns heavily influenced the original choice of the Hanford site in 1943 and subsequently the selection of the Savannah River and Idaho sites.

At the beginning of the Hanford operations, there was no precedent for the large-scale production and handling of radioactive materials, including wastes. The state-of-the-art was still advancing rapidly when the SRP and INEL projects were initiated. Over the past three decades of practical experience with the management of defense wastes, the EH&S concerns have come more clearly into focus, and technology for dealing with these issues has developed concurrently. The Defense Waste Management Program continues to address those concerns for which answers are or will be required in light of current or future plans and activities (Section II).

B. Areas of Concerns

The major specific EH&S concerns associated with the DWM programs are presented in Table III-1. EH&S research requirements relating to each concern are also presented and provide a basis for consideration in planning and focusing research programmatic actions to give answers to EH&S issues on a timely basis. Generic concerns, such as the biological effects of low-level radiation exposures, are not included but are to be addressed in a generic nuclear concerns and requirements document. It should be noted that Table III-1 does not include information directly related to the Commercial Waste Management (CWM) Program which may have some relevancy to the Defense Waste Program; the CWP Program is the subject of a separate EDP. The following subsections identify and discuss major health, safety, social and ecological concerns.

Health Effects

Risks of radiation exposure can exist with all operations and activities of the Defense Waste Management Program. Occupational and public exposures may result from effluents, spills; or unplanned releases from waste processing and handling facilities prior to and during waste storage, or from the leakage or escape of the longer-lived radionuclides from repositories or disposal sites following storage. Potential risks also exist from the use and handling of toxic industrial chemicals in the multitude of waste management operations.

Ecological Effects

The radioactive waste management operations have been of concern because of their potential biological effect on plants and animals and the environment. Many studies and activities have been directed to the understanding of the near-term impacts of radioactive effluents on plant and animal life at the DOE sites. Long-term impacts are not as readily discernible. Continuous efforts since the early 1940's have resulted in positive contributions to the understanding of the ecology and environment through such activities as the establishment of several major DOE sites (INEL, RL, SRP, LASL) as National Environmental Research Parks. Such efforts form a basis for continuous growth in our understanding of the world around us.

Land Use

Defense waste storage and handling facilities are on large installations (Hanford, INEL, Savannah River) occupying hundreds of square miles that provide relative isolation from the public. Some areas require, because of contamination and waste management operations, continued dedication to program use. However, there is a continuing need to evaluate the land requirements for program activities and what may be potentially releasable for commercial utilization (farming, grazing, industrial sites, etc.).

Societal Effects (Social, Political and Institutional)

The concern of the public and state and local governments in regard to the generation and handling of waste as a result of Federal government operations has become increasingly evident. As a result, the public, state and local governments have become more involved in the various procedural mechanisms related to major waste management actions (NEPA process, licensing, regulations)*. In order to promote the public confidence in the government's ability to handle its waste safely, the public and institutions must continue to be cognizant of waste management plans and activities and be given an opportunity to participate in the decision-making process so that waste management programs can proceed in a timely manner. Planning to achieve this desired level of involvement is a continuing need. The State Planning Council, established by Executive Order, will provide a means by which this involvement of state and other institutions can be further implemented. In dealing with the public and others, it is necessary that effective means be established to convey information in an understandable manner.

Occupational Safety

While safety is inherently related to the concern for the health of the individual, it is essential that continued attention be given to the means for minimizing the occurrence of incidents and the potentially harmful consequences of such incidents. The defense waste activities in many cases involve large plants, complex operations and hazardous materials. It is only through continued exercise of safety programs that such operational elements can be controlled and maintained to achieve an acceptable occupational risk.

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*To date, Defense waste management operations have not been subject to NRC licensing and regulation.

C. Analyses of Concerns and Requirements

As presented in Table III-1, there are twelve major areas of environmental, health and safety concerns. These areas are stated rather broadly in most cases so that the full impact of the concern is identified, particularly when the subject deals with relatively large quantities or volumes of materials representing very large amounts of radioactivity. The analyses in this section correlate the concern with the EH&S requirements and relate the history and ongoing effort, if any, to the resolution of the issue.

1. Ten million cubic feet (75 million gallons) of high-level wastes are currently stored in underground tanks or bins at DOE sites in the form of liquids, damp salt cake and calcine. These wastes represent sources of environmental, health and safety risks should leaks, ruptures, spills, or venting occur.

The large volume (about 75 million gallons) of high-level waste in the form of liquid, moist salt cake or calcine is a continuing concern. Waste has leaked into the surrounding soil from old storage tanks at Richland (24 confirmed leakers). Savannah River has experienced deterioration of waste tanks with leakage to the soil in two instances. Idaho has had no leaking waste tanks. Extensive efforts have been made to determine the possible migration of radioactive releases through the soil and into the food chain. Although the studies of possible pathways for public exposure have revealed nothing of major concern, measurement and monitoring efforts will necessarily continue. While these events seem to have resulted in little risk to the public, the societal impact has been significant (public distrust and lack of confidence). This signifies the need to continue to make the public aware of the risks as well as the safeguards incorporated in these waste management operations to protect the environment and the public.

New double-walled high-level waste tanks have been designed and used (at SRP and RL). Any additional tanks to be constructed will be required to be of this advanced design. The transfer of large volumes of high-level liquids and sludges from old tanks to replacement tanks requires care in handling and adherence to accepted radiation safety procedures. Improved methods for rapid detection of any leaks, principally because of the tank-in-tank design and the development of in-tank waste solidification technology, have substantially reduced the potential for losses from the tanks to the environment. Even with these improved facilities and techniques for interim storage operations, the continuing uncertainty about the time period these materials must be maintained under the interim storage regime before implementation of a long-term management program is a source of concern.

Efforts should continue to provide improved estimates of dose to the public considering all logical potential conditions for the interim storage operations. This is particularly true as the program continues for the transfer of high-level waste from tanks to waste treatment facilities when such process facilities are in place.

2. Current program efforts are under way to develop the capability to treat HLW currently in interim storage. Products from high-level waste treatment facilities will require interim and/or long-term isolation. A plan for the disposition (form, environment, etc.) of these wastes has not been established. The absence of an acceptable plan for the ultimate disposition of these wastes raises the question of whether the planning for the treatment of these wastes currently under way represents an acceptable EH&S risk.

The high-level defense waste management program includes the development of technology to place the waste in a form compatible with long-term storage or disposal. At Savannah River a reference process has been selected and initial designs have been completed to place the high-level waste products (cesium, strontium and the fission products and residual actinides) in a stable waste form. Hanford and INEL efforts to handle the HLW in interim storage at those sites have not progressed as rapidly. (Retrieval of waste salt cake from the Hanford tanks has yet to be demonstrated.) In any case, programs are well along with a clear objective of altering the present form (liquid, salt cake, calcine) of the inventory of waste. This program at SR has been addressed in the NEPA process with the issuance of the final program environmental impact statement for the long-term management of defense wastes at the Savannah River Plant. EIS's for other sites are under development or planned. Documents describing the technical alternatives for handling these wastes have been developed and issued. Another major issue remaining is the decision on the long-term disposition of the processed and treated wastes and the timing of that decision. (That is, the decision on waste form should be based on the acceptability of the waste at a repository.) At the present time, there is no accepted plan for the ultimate disposition of the wastes, such as in a geologic formation. It may be reasonably assumed that the treated wastes would be placed in a licensed repository accepting commercial wastes.* However, a planning base should be developed to identify the ultimate disposition of these wastes so that environmental, health and safety considerations are evaluated at an early stage to achieve a minimum risk. President Carter's February 1980 policy statement referenced the use of repositories to accept both defense and commercial wastes but the exact circumstances and timing need to be defined. The National Plan for Radioactive Waste Management which the President called for is being prepared and will address these matters.

3. Prior to the 1970's, solid TRU-contaminated wastes were buried. Subsequently, the TRU-contaminated wastes above the limit of 10 nCi/g were placed in 20-year retrievable storage pending a decision on the terminal disposition of stored TRU waste. Since the low-level waste materials buried prior to 1970 can exceed the 10 nCi/g limit, there remains the question of determining what to do about the buried TRU waste (exhume and treat or leave buried).

At the present time, low-level waste is buried. TRU-contaminated solid waste is now placed in 20-year retrievable storage. A considerable amount of plutonium and other actinides are contained in solid low-level wastes buried prior to 1970. In 1975 a program was initiated at INEL to demonstrate the capability to exhume buried TRU waste while defining the costs and hazards of such operations. As identified in Figure II-1, information will be developed in FY1981 to provide a basis for a policy decision regarding the exhumation of buried TRU wastes at INEL. To make this decision and decisions for TRU wastes at INEL and other sites (Richland, Savannah River, Los Alamos), a set of criteria must be established which would define the TRU wastes to remain buried and to be exhumed and treated if required. (This may require the reevaluation of the present 10 nCi/g criterion.) The criteria should reflect the evaluation of risk (probabilities and consequence) of injury to man and the environment in the exhumation of buried TRU wastes. Most of the technological inputs to this decision will be the result of the experience gained by the activities at INEL to demonstrate the capabilities, risks and problems in exhuming and handling buried TRU waste. The decision will be provided via the NEPA process.

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*Present planning calls for a licensed repository for commercially-generated HLW and spent fuel (referred to as a "commercial repository") to be made available ca. 1997-2006.

4. The disposition of the increasing inventories of TRU wastes stored in 20-year retrievable mode is yet to be determined. The interim storage and required rehandling of the mounting quantities of these wastes constitute an increasing radiation exposure risk to workers and the public, in particular as related to possible accidents and unplanned events.

TRU wastes are currently being placed in a 20-year retrievable storage mode and have been accumulating in this form since the 1970's. There are no current guidance or criteria established which define the disposition of this material nor the waste form requirements for acceptability in a particular long-term environment. The Waste Isolation Pilot Plant (WIPP) was to be a dedicated facility in geologic media (bedded salt) to accommodate DWM TRU wastes. However, President Carter has decided that the WIPP project should be canceled and the site be evaluated as a candidate for a commercial waste repository. (The President's notice to Congress on the WIPP rescission has not been accepted by the Congress.) As identified by President Carter in his Program for Radioactive Waste Management, repositories should be capable of receiving commercial and defense wastes. However, there is the need to resolve this uncertainty about WIPP and, in the event the alternative of utilizing a commercial repository prevails, detail plans and dates for implementing this policy to optimize the management of these wastes and to minimize risks to workers and the public. Inherent in this effort is the need to define the treatment required for TRU waste to meet the acceptance requirements of a licensed commercial waste repository. (Federal Government commitments were made to the State of Idaho that INEL TRU waste removal would start by the end of the 1970's.)

5. Radioactive high-level defense wastes from HLW treatment facilities must be disposed of in a manner such that their risk of return to the biosphere is acceptably low. The current alternatives under study include salt, basalt and granite geologic formations. The repository effort is not an ongoing DWM activity but is a major effort of the Commercial Waste Management Program. (For more complete discussion, see Table III-1 of the CWM EDP.)

This EH&S concern reflects the considerations associated with the long-term isolation and/or disposal in a geologic formation. As noted before, the President's statement on his Program for Radioactive Waste Management specifies that repositories should be capable of receiving commercial and defense wastes. The primary health and safety concern involves the ability of the repository to contain the waste and prevent its access to the biosphere until it no longer is a health hazard. Many factors are involved in this issue. Efforts are required to determine radioactive transport mechanisms (pathways), rock mechanics, thermal effects and radioactive effects on rocks, salt and other media, impacts of natural events, mining risks, and institutional and societal factors. The EH&S concerns and requirements associated with storage or disposal of HLW in a repository are considered in detail in the Commercial Waste Management EDP, because the HLW repository is a major element of the Commercial Waste Management Program. However, the DWM program must provide HLW in forms and packages compatible with repository requirements and other requirements of the CWM program.

6. The large quantities and different forms of radioactive waste materials that must be handled and treated in interim waste operations and long-term management technology programs present risks as a result of unplanned exposures and contamination hazards. Accidents and procedural errors, if

allowed to occur, could result in the release and dispersal of radioactive wastes creating sources of occupational and public exposure, or emergency conditions if excessive.

Operation of systems which produce radioactive materials and operations which treat the wastes for interim and/or long-term storage in most cases require the handling of large volumes and quantities of material varying in degree of radioactivity. Because of the quantities of materials and radioactivity, it is necessary to operate large facilities to perform the required services which, in many instances, require complex technology and engineering. Proper engineering and equipment, instrumentation and safety systems are key elements at these major waste management facilities. Performance goals for these waste management operations require careful planning and implementation of safety programs Of critical importance is the human element, the people who control the systems. Because of the nature of the systems and the materials handled, safety of operations is a primary objective. The result of this emphasis on safety is shown by the record of safety within the program for the last 35 years. However, safety is a continuing concern which must consider the unexpected from the physical and human elements. Efforts should continue to identify possible accident modes and sequences and to address the need to minimize human error still further through updated procedural directions, retraining, recertification, supervisory involvement and the use of modern techniques to remind workers of their responsibilities and capabilities. In addition the design of handling and processing systems should be such as to minimize exposures in plant and equipment maintenance (that is, remote maintenance versus contact). The DOE Safety Analysis and Review System (SARS) provides the implementing requirements to address this concern.

7. Large quantities of defense low-level waste currently in DOE burial or storage sites represent potential sources of radiation exposure to man and his environment. Leaching and drainage of waste stored in shallow earth burial trenches are continuing concerns because of the risk of release of radioactivity to the ground, water and atmosphere, with potential subsequent exposure of people.

Low-level radioactive wastes have been generated in significant quantities since the early 1940's by the nuclear weapons and defense activities. Shallow land burial techniques used for disposal have changed very little over the years. Radioactivity from shallow-burial sites may enter the biosphere in one or more of the following ways:

- Leaching of radioactive materials with subsequent transport to an aquifer resulting in contamination of water supply.
- Radioactivity in leachates, soluble materials and corrosion products taken up by deep-rooted trees and plants or by burrowing animals and insects, thus entering the food chain to create a radiation exposure risk to man and other living creatures.
- Radioactive contamination transported to surface soil and resuspended as airborne particulates causing an inhalation hazard to storage-site workers and the public.

It is estimated that more than 60 million cubic feet of low-level solid waste (including 9 million cubic feet of buried TRU waste) are currently buried in shallow back-filled trenches at 14 Government-owned waste burial sites throughout the country. The potential for significant public and occupational risks from direct exposure to these low-level wastes is considered low; however, the acceptable risks associated with possible leaching of radioactive materials into water supplies and transport to the food chain need to be determined. Of importance in these determinations is the role biotic systems play in transporting (and possibly concentrating) radioactive materials to humans. An increase is needed in the confidence and accuracy with which models can be developed and used to estimate the performance of the disposal systems over periods of interest and the resulting radiation dose to man. These models require data on radionuclides (source terms), their migration through the geologic/hydrologic environment, and their transfer along potential groundwater and food chain pathways. There is a generic need to upgrade the accuracy of the uptake, transfer and deposition coefficients used in these models. The role of vegetation and burrowing animals in translocating radionuclides from buried wastes to the surface of the ground requires continuing study, including the verification of models.

The long-term burial technology program should better define these potential problem areas and provide alternative solutions, including alaternative disposal technologies.

8. Separation and storage of increased quantities of radioactive airborne wastes, which will result from compliance with the potential EPA regulations calling for lower concentration limits on the release of gaseous radioactive effluents, may significantly increase occupational radiation exposure risks.

In the operation of the defense chemical processing plants, all noble gases are essentially emitted through the vessel off-gas system and stack to the atmosphere. Other volatiles, such as iodine and ruthenium, are treated in some form or manner as part of the processing system with residual emissions meeting DOE standards. Future EPA regulations (Clean Air Act, Section 112) may require retention of Kr-85, C-14 and more efficient cleanup of the off-gas stream of iodine, tritium and ruthenium. The collection and storage of these materials required to meet more stringent emission standards and regulations result in increased risk of occupational exposure from concentrated in-plant sources of these stored radioactive wastes. An assessment of the risks/benefits of airborne waste isolation in comparison to the public and environmental risks/benefits of wide atmospheric dispersion of these wastes is required. Improved dose assessments and the development of effective control technology are part of this risk/benefit evaluat The DWM program is addressing and will continue to address this concern. It is not clear if and when the government facilities could be modified and processes adjusted to meet the new standards, assuming that the required technology is successfully demonstrated.

9. Potentially hazardous chemical substances are used in waste management processing operations and exist in some waste streams. These are a potential source of occupational exposure and subsequent health impacts. Threshold limit values may not exist for all chemicals in use.

The industrial chemicals used to process defense wastes are commonly used in other industrial plants and do not pose any unusual or uncontrollable health hazards to workers or the public. Nevertheless, the potential risks associated with some of the chemicals and compounds may not be fully understood, particularly in today's environment where research continues to identify new chemical hazards to man. It is necessary to continue the evaluation of toxicity and other risks associated with such materials taking into account any new information developed about their hazards to assure protection of workers.

Threshold limit values (TLVs) may not exist for some of the special or unique chemicals used in DWM facility processes and operations. For chemicals of this nature, an evaluation of the potential health risks associated with their use will be required. Chemicals in common use in industrial as well as DWM operations are controlled by already established industrial hygiene, occupational safety and environmental protection regulations and criteria. However, their disposal has not been that well controlled: but: they will be subject to environmental standards compatible with those issued by EPA in mid-FY1980 under the Resource Conservation and Recovery Act (RCRA) (42USC6901).

10. Site preparation and facility construction and operation activities at DWM sites will result in many disturbances, such as noise, thermal discharges, dust, earth cover removal and runoff, habitat and food source destruction which may cause irreversible ecological changes and imbalances in the areas surrounding the facilities.

Base-line and post-operation ecological studies have been conducted in the areas surrounding each of the DOE reservations that produce special nuclear materials and handle defense wastes. These studies have looked for acute and subtle disturbances of the environment and ecological balance as reflected in changes in the census and health of plant and animal populations. Many studies have been conducted over the past 35 or more years. Where ecological disturbances have been observed, they have been attributed to causes other than radiation.

However, these past and ongoing studies were not designed to detect long-term subtle ecological changes that may result from the combined effects of all DWM and Special Nuclear Material Production (SNM) activities and operations. Improvements are needed in techniques for detecting and assessing such subtle ecological changes in order to forecast potential effects from future environmental insults. The large reservations accommodating DWM operations provide controlled territories and unique opportunities for advancing the state-of-the-art in conducting this kind of ecological research. This has been recognized through the establishment of a National Environmental Research Park at each of the Savannah River, Hanford, Idaho and Los Alamos sites. Efforts should be encouraged at these installations to study the integrated impacts of operations on the ecological environs and to transfer these data to the nuclear industry in this country and abroad.

11. Current defense waste storage facilities are located at various sites within large Government-owned reservations hundreds of square miles in total land area. Compatible alternative uses for some of the land in these reservations have been developed, such as environmental research parks, wildlife management areas, commercial nuclear power sites, and commercial waste burial grounds. Social pressure continues at some locations for the release of additional land areas for alternative uses. However, there are land requirements for siting future DWM facilities.

The defense waste storage areas are located on large reservations occupying several hundred square miles (e.g., Hanford - 600, Savannah River - 300). There are growing pressures (for example, from GSA) to make some of this land available for various public or other uses, but many factors must be considered before this decision can be made. Such proposed land use obviously cannot be permitted if it would compromise the need for continued safety of DWM operations, interfere with defense programs or create public health risks. Alternative land use would not be permissable at or near places where wastes are processed or stored and places where soild columns are contaminated with radionuclides. Several alternative land uses that are compatible with the DWM operations have been initiated on major portions of DOE reservations (but not within the exclusion areas dedicated to DWM operations). These include environmental research parks, wildlife management areas, commercial nuclear power sites, and commercial waste burial grounds.

In view of the continuing pressures at some sites for the conversion of reservation land to other uses, increased effort on land use planning is required including the development of up-to-date technical information on appropriate size of buffer zones, on future needs for waste storage and disposal, and on decontamination and decommissioning capabilities so that proper judgments can be made on how best to manage the land resources.

12. Resolution of societal concerns is of crucial importance to public acceptance of the Defense Waste Management Program. Public concerns include: (1) technical feasibility of safe handling and permanent isolation of waste; (2) location of storage/disposal sites; (3) who should make irreversible decisions in the DWM program and how such decisions are made (procedural); (4) who should have the responsibility for long-term management (including surveillance and safeguarding); (5) transfer of responsibility to future generations; and (6) more public input into the decisionmaking process.

The major socioeconomic concerns associated with DWM address the same basic questions of where and under what conditions should radioactive waste be managed so that the associated risk is acceptable to the public. In the context of the DWM program, this question is being raised in the form of concern about leaking waste tanks, the need for corrective action plans involving potential radioactive releases and incidents, long-term management (disposal) capabilities, and the assurance that these wastes once disposed of will remain isolated from man and his environment for the necessary long time periods. While the resource requirements to manage these wastes effectively have not been a major public concern, this issue has been raised on occasion as representing large hidden costs for the national defense system.

Besides the public interest in leaking tanks, there is the added concern about the radiological risks associated with the removal of wastes from these tanks, which is inherent in any alternative for the interim and long-term handling of these defense high-level wastes. Retrieval of the wastes from the tanks has yet to be demonstrated at RL. (SR has successfully demonstrated the transfer of the waste from tanks.) The added question concerns what to do with the wastes outside of their present conditions. What form will they be converted to and where will the waste be placed? At present there is no definitive plan for these final dispositions, a situation that has not gone unnoticed by large segments of the public. The public and various action groups are insisting that greater consideration be given to their input in the selection of waste disposal options. The resolution of this concern involves not only a determination of how best to obtain a truly representative public input for consideration in the decision-making process, but also how best to inform the public so it has a basis for its consideration. At the same time, this process should not risk the implementation of the technology program which is designed to minimize the risk to the public.

The President, in his Program for Radioactive Waste Management, committed the Administration to the development of a comprehensive National Plan for Nuclear Waste Management. In addition the President committed the waste management program to be conducted with full disclosure to and participation by the public and technical community. A number of activities in the waste management program offer opportunities for public participation including: Congressional-DOE budget cycle hearings, NEPA process public forums, NRC licensing hearings, National Academy of Sciences reviews, advisory committee technical meetings, and local public information meetings. The State Planning Council is a mechanism which will provide for future state and local participation.

Table III-1

ENVIRONMENTAL, HEALTH & SAFETY CONCERNS AND REQUIREMENTS

Program: Defense Waste Management

Program Element	EH&S Impact Area(s)(a)	EH&S Concern	EH&S Research Area(a)	EH&S Requirements	Status of EH&S Requirements(b)	Requirement End Item & Time	Comments
Interim Waste Operations	5, 6	DWM-1 Ten million cubic feet (75 million gallons) of high-level wastes are currently stored in underground tanks or bins at DOE sites in the form of liquids, damp salt cake, and calcine. These highly radioactive wastes represent sources of environmental, health and safety risks should leaks, ruptures, spills, or venting occur.	1.3, 1.4	DWM-1.1 Evaluate and verify adequacy of methods for early detection and measurement of radioactive materials that could escape from storage sites and facilities.	A	Surveillance criteria plus operating procedures. Update on a continuing basis.	Included in NEPA documentation (EIS's) and in SAR's.
			2.1, 4.4	DWM-1.2 Continue to update estimation of dose to people via all logical exposure pathways for future storage operations and concepts.	A	Updated procedures, site selection and design criteria. Update on continuing basis. Keep consistent with future program needs.	Included in NEPA documentation (EIS's).
			7.2	DWM-1.3 Assess, develop and test methods and processes for reduction of risks by reducing the volume of waste and conversion to stable forms acceptable for interim storage but compatible with long-term storage and eventual disposal requirements.	A	Criteria, operating procedures for interim management of HLW (198 at RL, SR)	Improved storage facilities to be in place by FY1992.

a. The EH&S Impact Area and EH&S Research Area numbers refer to the categories presented in Appendix C, "Taxonomy for EDP Concerns and Requirements Table."

b. Status code: A - Projects ongoing; B - Projects planned; C - Projects not yet funded or planned but needed.

Table III-1 (Cont.)
ENVIRONMENTAL, HEALTH & SAFETY CONCERNS AND REQUIREMENTS

Program: Defense Waste Management

Program Element	EH&S Impact Area(s)(a)	EH&S Concern	EH&S Research Area(a)	EH&S Requirements	Status of EH&S Requirements(b)	Requirement End Item & Time	Comments
Long-Term Waste Management Technology	3, 5	DWM-2 Current program efforts are under way to develop the capability to treat HLW currently in interim storage. Products from high-level waste treatment facilities will require interim and/or long-term isolation. A plan for the ultimate disposition (form, environment, etc.) of these wastes has not been established. The absence of an acceptable plan for the ultimate disposition of these wastes raises the question whether the planning for the treatment of these wastes currently under way represents an acceptable EH&S risk.	2.3	DWM-2.1 Develop and test waste forms and encapsulants to determine their integrity and suitability for the interim and long-term storage in alternative environments.	A	Acceptable waste forms and encapsulants. NEPA Review (1983,SR; 1986,RL; 1991,ID).	Needs to be integrated with total waste management program effort, including commercial waste repository program and activities. The commercial waste repository could serve as the repository for DWM/HLW.
			3.4, 6.3, 7.2, 8.1	DWM-2.2 Assess the various alternatives of waste form and disposition environments to determine acceptability of risks to health and safety of workers and public.	A	Recommended waste form and disposal strategies. NEPA Review (1983,SR: 1986,RL; 1991,ID)	
			7.2, 8.5	DWM-2.3 Develop a plan for the long-term storage/isolation of defense waste treatment facility product in a suitable environment.	A	To be included in the OWM National Waste Management Plan and Comprehensive Implementation Plan (1980. 1981). NEPA Review (1983,SR; 1986,RL; 1991,INEL).	Alternative dispositions should be addressed through the NEPA process.

Table III-1 (Cont.)

ENVIRONMENTAL, HEALTH & SAFETY CONCERNS AND REQUIREMENTS

Program: Defense Waste Management

Program Element	EH&S Impact Area(s)(a)	EH&S Concern	EH&S Research Area(a)	EH&S Requirements	Status of EH&S Requirements(b)	Requirement End Item & Time	Comments
Interim Waste Operations	3, 5, 6	DWM-3 Prior to the 1970's, solid TRU-contaminated wastes were buried. Subsequently, the TRU-contaminated wastes above the limits of 10 nCi/g were placed in 20-year retrievable storage pending a decision on the ultimate disposition of stored TRU waste. Since low-level materials buried prior to 1970 can exceed the 10 nCi/g limit, there remains the question of determining what to do about the buried TRU waste (exhume and treat or leave buried).		DWM-3.1 Evaluate the EH&S considerations for determining whether TRU wastes should be exhumed and processed, and what waste forms are acceptable for long-term storage/disposal. A re-examination of the 10 nCi/g value as the criteria for TRU retrievable storage is required.	A	Decision on exhumation and operating criteria. (1981 at ID)	EPA numerical standard for HLW and TRU waste to be issued in CY1981; NRC regulations in final form to be issued by 1981. Decision to be addressed in NEPA process. NEPA documentation completed at all sites in 1984.
			2.1,6.3	DWM-3.1.1 Assess EH&S risks of leaving in place - characteristics, quantities, pathways to the environment, migration rates, intrusions, etc.	A	Report - basis for decision (1981-1984)	
			6.3	DWM-3.1.2 Assess EH&S risks of exhumation-exposures to workers and public.	A	Report - basis for decision (1981-1984)	
			6.3,7.2	DWM-3.1.3 Assess EH&S risks for long-term retrievable storage/disposal.	A	Report - basis for decision (1981-1984)	
			8.3	DWM-3.1.4 Develop overall risk/benefit and establish operating criteria.	A	Report, Criteria (1981-1986)	

Table III-1 (Cont.)

ENVIRONMENTAL, HEALTH & SAFETY CONCERNS AND REQUIREMENTS

Program: Defense Waste Management

Program Element	EH&S Impact Area(s)(a)	EH&S Concern	EH&S Research Area(a)	EH&S Requirements	Status of EH&S Requirements(b)	Requirement End Item & Time	Comments
Long-Term Waste Management Technology	3, 5, 7, 9	DWM-4 The disposition of the increasing inventories of TRU wastes stored in 20-year retrievable mode is yet to be determined. The interim storage and required rehandling of the mounting quantities of these wastes constitute an increasing radiation exposure risk to workers and the public, in particular as related to possible accidents and unplanned events.	7.2, 8.3	DWM-4.1 Develop plan for the long-term disposition of defense TRU wastes placed or to be placed in 20-year retrievable mode in a suitable environment.	A	Disposition plans and policies. Part of National Waste Management Plan (NWMP) (1981)	With the proposed cancellation of the Waste Isolation Pilot Plant (WIPP), there is no designated repository for TRU wastes. It could be assumed that DWM TRU wastes can be a candidate for the commercial waste repository.
			7.2	DWM-4.2 Develop treatment technology to place TRU waste in a form acceptable for long-term storage and/or to meet repository acceptance criteria.	A	Waste form criteria and standards (1984)	INEL treatment facility scheduled to start construction in 1984. Unknown if waste form acceptable at repository.

Table III-1 (Cont.)

ENVIRONMENTAL, HEALTH & SAFETY CONCERNS AND REQUIREMENTS

Program: Defense Waste Management

Program Element	EH&S Impact Area(s)(a)	EH&S Concern	EH&S Research Area(a)	EH&S Requirements	Status of EH&S Requirements(b)	Requirement End Item & Time	Comments
Long-Term Waste Management Technology	1, 3, 4, 5	DWM-5 Radioactive high-level and TRU defense wastes from HLW and TRU treatment facilities must be disposed of in such a manner that the risk of their return to the biosphere is acceptably low. The current alternatives under study include salt (bedded and domed), basalt, and granite geologic formations. The repository effort is not an ongoing DWI activity, but is a major effort of the Commercial Waste Management Program. It is expected to also accommodate defense HLW and TRU. (For more complete consideration, see Table III-1 of the CWM EDP.)		DWM-5.1 (See CWM EDP) Study the long-term containment and transport of radioactive materials through various geologic formations to confirm isolation potential of candidate geologic sites and formations.	A	Reports PSAR (1987)	
			2.1, 2.2, 2.3, 2.4	DWM-5.1.1 Confirm the containment potential of the geologic formations of candidate sites.	B	Reports (1981-1985)	Confirmation may require in situ testing.
			2.3	DWM-5.1.2 Determine the effects of radiation on the integrity of geologic formations.	A	Reports, design criteria (1984-1985)	Ongoing studies; in situ experience after site excavated - long-term program.
			2.3	DWM-5.1.3 Determine the thermal effects on the integrity of geologic formations.	A	Reports, design criteria (1984-1985)	Ongoing studies; in situ experience after site excavated.
			2.1, 2.2, 2.3, 4.4	DWM-5.1.4 Improve and verify modeling of the transport and migration of radionuclides in geologic formations (i.e., identify, define mechanics and interactions and evaluate the pathways to man).	A	Improved models (PSAR, 1987)	

Table III-1 (Cont.)

ENVIRONMENTAL, HEALTH & SAFETY CONCERNS AND REQUIREMENTS

Program: Defense Waste Management

Program Element	EH&S Impact Area(s)[(a)]	EH&S Concern	EH&S Research Area[(a)]	EH&S Requirements	Status of EH&S Requirements[(b)]	Requirement End Item & Time	Comments
		DWM-5 (Cont.)	8.5	DWM-5.1.5 Develop a system for maintaining records of the kinds, quantities, and exact locations of wastes that are placed in a repository.	C	Operating Procedures (PSAR, 1987)	Exact location will only be known when emplaced.
			7.1, 8.1, 8.3	DWM-5.1.6 Develop site acceptance and waste form criteria for geologic disposal.	A	Criteria	EPA to issue HLW standard in March 1981. NRC regulation to be issued by 1981.
			7.1, 7.2	DWM-5.1.7 Develop and test rock-mass drill-hole sealing methods and materials to provide repository seals which will not leak or be permeable.	A	Seals and sealing technology PSAR (1987)	

Table III-1 (Cont.)

ENVIRONMENTAL, HEALTH & SAFETY CONCERNS AND REQUIREMENTS

Program: Defense Waste Management

Program Element	EH&S Impact Area(s)(a)	EH&S Concern	EH&S Research Area(a)	EH&S Requirements	Status of EH&S Requirements(b)	Requirement End Item & Time	Comments
Interim Waste Operations Long-Term Waste Management Technolog	5, 6	DWM-6 The large quantities and different forms of radioactive waste materials that must be handled and treated in interim waste operations and long-term management technology programs present risks as a result of unplanned exposures and contamination hazards. Accidents and procedural errors, if allowed to occur, could result in the release and dispersal of radioactive wastes, creating sources of occupational and public exposure, or emergency conditions if excessive.	8.1	DWM-6.1 Determine the potential for accidents at DWM facilities, including natural disasters, criticalities, explosions and fires.	A	SAR's, operating procedures. Continuing efforts for new and current facilities	
			1.2	DWM-6.2 Identify and study the sources of radioactive materials and probable mechanisms that could cause serious exposure and contamination conditions, should accidents occur.	A	Report on hazards, inventories and characterizations. Continuing effort.	
			8.5	DWM-6.3 Develop and review health protection and emergency action plans for implementation under accident conditions of various degrees of severity.	A	Emergency actions and evacuation plans; personnel medical aid and decontamination plans. Continuing effort.	

Table III-1 (Cont.)

ENVIRONMENTAL, HEALTH & SAFETY CONCERNS AND REQUIREMENTS

Program: Defense Waste Management

Program Element	EH&S Impact Area(s)(a)	EH&S Concern	EH&S Research Area(a)	EH&S Requirements	Status of EH&S Requirements(b)	Requirement End Item & Time	Comments
Interim Waste Operations	2, 3, 4, 5	DWM-7 Large quantities of low-level solid defense wastes currently in DOE burial or storage sites represent potential sources of radiation exposure to man and his environment. Leaching and drainage of wastes stored in shallow earth burial are a continuing concern because of the risk for release of radioactivity to the ground, water and atmosphere, with subsequent exposure of people.	2.1, 2.2, 3.2, 8.4	DWM-7.1 Continue to update dose estimates through the determination and use of knowledge regarding the physical and chemical forms of radionuclides released, dispersion in the atmosphere, transport in groundwater, surface water, and concentration in food chains.	A	Updated dose estimates. Continuing effort.	Has been addressed in NEPA process. Continuing as long as wastes remain stored on-site.
			3.4, 4.4	DWM-7.2 Continue to update knowledge and assessments of ecological cycling of radioactive pollutants and potential exposure pathways of released radioisotopes to man.	A	Report. Continuing effort	Contribution to development of plans and decisions on future waste treatment and management.
			2.3, 7.2	DWM-7.3 Develop and assess improved methods for storage of low-level defense wastes. Investigate means of minimizing risk of leakage by stabilization of disposed materials through improved packaging & site environment. Siting evaluations will be included in these efforts.	A	Improved procedures, techniques and burial locations (1983-1984)	Demonstration of advanced treatment technology to be completed in FY 1985

Table III-1 (Cont.)

ENVIRONMENTAL, HEALTH & SAFETY CONCERNS AND REQUIREMENTS

Program: Defense Waste Management

Program Element	EH&S Impact Area(s)[a]	EH&S Concern	EH&S Research Area[a]	EH&S Requirements	Status of EH&S Requirements[b]	Requirement End Item & Time	Comments
Interim Waste Operations	1, 5, 6	DWM-8 Separation and storage of increased quantities of radioactive airborne wastes, which will result from compliance with the potential EPA regulations calling for lower concentration limits on the release of gaseous radioactive effluents, may significantly increase occupational radiation exposure risks.	7.2	DWM-8.1 The environmental control technology aspects of collection, containment, storage and disposal of airborne radioactive wastes will be studied and evaluated to derive an effective separation and storage methodology to satisfy interim waste operations requirements.	A	Report, system design criteria (1983)	
			8.1, 8.4	DWM-8.2 Dose assessments and required measurements and monitoring should be conducted to obtain reliable estimates of occupational exposure risks and public dose, before and after procedures for separation and storage of airborne wastes are initiated.	A	Dose assessment (1983). Criteria and operating procedures, emergency accident procedures for facilities where installed.	
			7.2	DWM-8.3 Program stragegy and planning is needed to identify the disposition of gaseous waste that is collected and stored.	B	National Waste Management Plan (1981)	A commercial waste repository should be a candidate, in which case the form and packaging, etc., must meet licensing requirements. No firm plans to modify DOE facilities to collect gaseous wastes.

Table III-1 (Cont.)

ENVIRONMENTAL, HEALTH & SAFETY CONCERNS AND REQUIREMENTS

Program: Defense Waste Management

Program Element	EH&S Impact Area(s)[(a)]	EH&S Concern	EH&S Research Area[(a)]	EH&S Requirements	Status of EH&S Requirements[(b)]	Requirement End Item & Time	Comments
Applicable to Multiple Program Elements	5, 6	DWM-9 Potentially hazardous chemical substances are used in waste management processing operations and exist in some waste streams. These are a potential source of occupational exposure and subsequent health impacts. Threshold limit values may not exist for all chemicals in use.	1.1, 1.2	DWM-9.1 Survey DOE waste management facilities and operations to identify and characterize hazardous wastes generated and utilized.	C	Hazardous waste inventory (1981)	Hazardous waste handling, treatment and disposal are not responsibilities of DWM as a program, but are an inherent or generic responsibility in all operations and programs.
			3.1, 3.4, 4.2, 8.4	DWM-9.2 Reevaluate the potential for exposure to hazardous chemicals and determine the health (generic) risks	C	Risk assessment (3-5 years)	Occupational exposure limits for most chemicals controlled by other agencies.
			1.3, 1.4	DWM-9.3 Reevaluate the capebility for characterizing and monitoring hazardous concentrations of toxic chemicals in DWM facilities and environs where a significant risk is present.	C	Reports (1-2 years)	EPA hazardous waste standards promulgated in 1980.
			1.3, 8.4	DWM-9.4 Determine and implement control techniques and procedures to comply with current and emerging standards	C	Facility and operations modifications and standard operating procedures on a time schedule consistent with State and Federal permit requirements	EPA hazardous waste standards promulgated in 1980.

Table III-1 (Cont.)

ENVIRONMENTAL, HEALTH & SAFETY CONCERNS AND REQUIREMENTS

Program: Defense Waste Management

Program Element	EH&S Impact Area(s)[(a)]	EH&S Concern	EH&S Research Area[(a)]	EH&S Requirements	Status of EH&S Requirements[(b)]	Requirement End Item & Time	Comments
Interim Waste Operations, Long-Term Waste Management Technology	4	DWM-10 Site preparation and facility construction and operation activities at DWM sites will result in many disturbances, such as noise, thermal discharges, dust, earth cover removal and runoff, habitat and food source destruction, which may cause irreversible ecological changes and imbalances in the areas surrounding the facilities.	4.1	DWM-10.1 Conduct baseline ecological studies at new DWM storage or waste treatment sites to provide valid assessments of effects of future facility construction and operation activities.	A	Reports, continuing effort	Modify operating procedures; design criteria as appropriate.
			1.1, 1.3, 1.4, 4.1	DWM-10.2 Establish and conduct ecological monitoring and analysis programs to determine the effects of operating facilities on ecosystems in the environments surrounding the DWM facilities.	A	Baseline data, continuing effort at operating site.	Modify operating procedures; design criteria as appropriate.

Table III-1 (Cont.)

ENVIRONMENTAL, HEALTH & SAFETY CONCERNS AND REQUIREMENTS

Program: Defense Waste Management

Program Element	EH&S Impact Area(s)(a)	EH&S Concern	EH&S Research Area(a)	EH&S Requirements	Status of EH&S Requirements(b)	Requirement End Item & Time	Comments
Interim Waste Operations Long-Range Waste Management Technology	3	DWM-11 Current defense waste storage facilities are located at various sites within large Government-owned reservations hundreds of square miles in total land area. Compatible alternative uses for some of the land in these reservations have been developed, such as environmental research parks, wildlife management areas, commercial nuclear power sites, and commercial waste burial grounds. Social pressure continues at some locations for the release of additional land areas for alternative uses. However, there are land requirements for siting future DWM facilities.	5.5, 8.3	DWM-11.1 Develop criteria for buffer zones and for compatible use (government and private) of coterminous lands.	A	Criteria (1981)	
			5.5	DWM-11.2 Develop long-range objectives, criteria and plans for the use and/or disposition of lands not required for DWM facilities.	C	Long-range land management plans and criteria (1982)	Consistent with National Waste Management Plan (1981) which would identify long-term waste management facilities and operations, from site selection through decommissioning.

Table III-1 (Cont.)

ENVIRONMENTAL, HEALTH & SAFETY CONCERNS AND REQUIREMENTS

Program: Defense Waste Management

Program Element	EH&S Impact Area(s)(a)	EH&S Concern	EH&S Research Area(a)	EH&S Requirements	Status of EH&S Requirements(b)	Requirement End Item & Time	Comments
Applicable to all DWM program sub-activities	7	DWM-12 Resolution of societal concerns is of crucial importance to public acceptance of the Defense Waste Management Program. Public concerns include: (1) technical feasibility of safe handling and permanent isolation of waste; (2) location of storage/disposal sites; (3) who should make irreversible decisions; (4) who should have the responsibility for long-term management (including surveillance and safeguarding); (5) transfer of responsibility to future generations; and (6) more public input into the decision-making process.	5.1, 6.3	DWM-12.1 Determine, through samplings, questionnaires and analysis of public documents, the public's majority opinion and perception of what constitutes an acceptable risk relative to long-term storage/disposal options and the major program considerations.	A	An evaluation of public perception to be incorporated in the decision-making process with a greater chance of public acceptance of decisions. Continuous process as dictated by major decisions and/or events.	Public input is incorporated in the NEPA process, issuance of standards such as the EPA HLW standard (1981), and NRC regulations where applicable. Public interface resulting from CWM activities (repository, low-level site selection) may be applicable to DWM. The State Planning Council should provide input.
			5.3	DWM-12.2 Improve procedures for obtaining the public input so that it can be considered in the decision-making process for major commitments such as: (1) the selection of waste storage/disposal options; (2) institutional arrangements for long-term storage/disposal management; and (3) irreversible commitments.	B	Continuous process as dictated by major decisions and/or events	The State Planning Council should be a key element as a source of input. NEPA process also serves this purpose.

Table III-1 (Cont.)

ENVIRONMENTAL, HEALTH & SAFETY CONCERNS AND REQUIREMENTS

Program: Defense Waste Management

Program Element	EH&S Impact Area(s)[a]	EH&S Concern	EH&S Research Area[a]	EH&S Requirements	Status of EH&S Requirements[b]	Requirement End Item & Time	Comments
Applicable to all DWM program sub-activities	7	DWM-12 (Cont.)	5.4	DWM-12.3 Determine the best mechanisms for long-term surveillance and safeguarding of waste and waste isolation sites.	A	Long-term surveillance requirements; plan to achieve acceptance. National Nuclear Waste Management Plan (1981)	Will most likely evolve over time. Regulatory process and State Planning Council should provide inputs.
			5.3, 5.4	DWM-12.4 Work out jurisdictional authority between Federal, state, and local agencies for prospective waste management activities.	A	Legislation. Continuing effort.	President's Program for Radioactive Waste Management has identified state and local government participation in site selection and other activities.
			5.1, 5.4	DWM-12.5 Improve public perceptions and knowledge of the DWM Program.	C	Public Education Plan on the DWM Program (1981)	Could incorporate elements of all activities (NEPA, State Planning Council, Public Information Plan).

IV. ENVIRONMENTAL STRATEGY

A. Environmental Program Plan

1. Coordination

1.1 Environmental Coordinating Committee

To assist in implementing this EDP, an Environmental Coordinating Committee (ECC) has been established. Environmental Coordinating Committees are constituted under authority of DOE Order 5420.1 and , since the EDP process is a joint EV and technology program effort, are composed of representatives of various DOE offices to assist in the implementation of the DOE Environmental Development Plan (EDP) System.

The primary function of an Environmental Coordinating Committee (ECC) is to monitor and overview the status of environmental R&D programs to ensure that the intent of the Environmental Development Plan is achieved, and to promote regular information exchanges and coordination between offices responsible for environmental R&D.

Specifically, the ECC,through appropriate subcommittees:

- Participates in the preparation and review of EDPs and identifies the need for and recommends revisions in EDPs.
- Maintains a collective awareness of the content, status, and results of environmental R&D efforts and periodically apprises management of status and issues
- Advises management of gaps, redundancies, and potential conflicts in the R&D efforts and recommends corrective options for management consideration.

Coordinates between performing offices those physical and institutional arrangements required for conduct of research efforts.

The ECC membership is appointed by ASEV, the responsible energy program Assistant Secretary, and the Director, Energy Research. In principle, the membership consists of one representative from each performing division and such special designees as assigned by the appointing officers. The chairmanship of the ECC is assigned to the representatives from the TAD, Office of Environmental Assessments (OEA) under the ASEV.

As the scope and complexity of a technology program warrant, the ECC can exercise the option to authorize the formation of subcommittees for an individual technology subprogram area(e.g., DWM). The duties and functions of the subcommittee are commensurate with the ECC. The subcommittee reports its findings, recommendations, and comments to the ECC.

Coordination is necessary to assure that required environmental (EA, EIS, Environmental Readiness Document-ERD) and Safety Analyses Reports (SAR) are appropriately scheduled to match the technology program milestones. A brief summary of these documents is provided in Appendix D.

1.2 Technology Assessments Division (TAD)

TAD is responsible for the day-to-day coordination of the EDP. A fundamental goal of the EDP implementation is to involve technical personnel responsible for EH&S activities with the staff of the technology programs. EH&S issues will be considered and resolved on a schedule consistent with the OWM program development and implementation. Completion of evaluations identified by requirements may show these issues to be of no consequence or, on the other hand, may reveal unanticipated issues and new requirements. Health and safety personnel can assist in the resolution of these issues by being involved in the coordination effort.

2. Coordinated Technology - Environmental Schedule

Figures IV-1 through IV-5 identify the Defense Waste Management Program technology and activity milestones with the environment-related milestones. The latter includes the NEPA documentation, standards, regulations and licensing where applicable. It also identifies requirements for the preparation of Environmental Readiness Documents. Figure IV-6 is provided to identify in a simple manner the correlation between the organizational element having primary responsibility for activities to satisfy specific requirements and the time at which they are required. The environmental schedules shown in Figure IV-1 through IV-5 identify over thirty documentation requirements made up of safety analysis reports, environmental impact statements and environmental readiness documents. The schedules do not take into account all of the required environmental assessments nor do they reflect any documentation requirements introduced through the licensing process for such activities as those involving repositories for high-level and/or TRU waste. The NEPA process and licensing considerations for the repository are stated in the LWR Commercial Waste Management EDP.

A basic objective of the EDP is to identify and schedule EH&S research and development and other activities necessary to resolve issues or concerns identified in the EDP in a timeframe which would allow the information developed to be considered in the major technology decisions. This EDP departs from this standard approach because of the inherent nature of the waste management activities which in themselves are activities to satisfy EH&S concerns. Thus the program and supporting activities and the associated EH&S documentation suffice to identify an integrated and correlated plan. Appendices B-1, B-2, and B-3 reference supporting research and development resulting from a literature search but are not referenced by goal or timing. A vast amount of EH&S research and development related to radiation health effects, monitoring, measurement and characterization and environmental transport characteristics has been conducted over the past thirty years (in direct response to the needs of the DWM). Where appropriate these data have been incorporated in standards, operating procedures and emergency plans. Future waste management activities will make use of this data base.

B. Program Strategy

Table III-1 identifies the EH&S concerns of the DWM program and correlates the requirements to mitigate these concerns. Figures IV-1 through IV-5 identify program milestones which are correlated with the NEPA requirements, standards, regulations and licensing as appropriate. Table IV-1 discusses the strategy for resolving each specific requirement and identifies the organizations involved in the development and coordination process. The strategy is graphically portrayed in Figure IV-6 for each of the EH&S requirements.

FIGURE IV-1
COORDINATED TECHNOLOGY AND ENVIRONMENTAL MILESTONES
INTERIM WASTE OPERATIONS

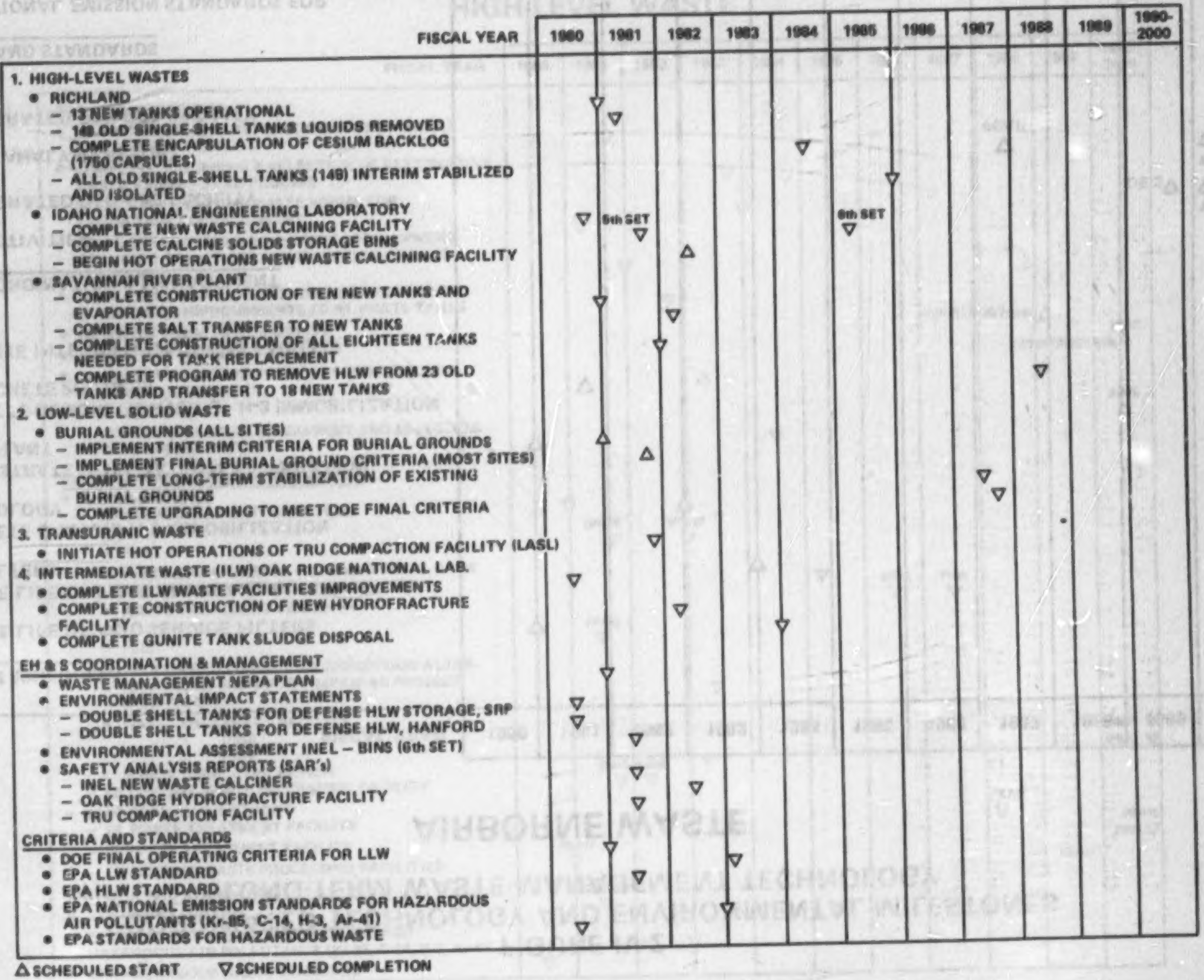


FIGURE IV-2
COORDINATED TECHNOLOGY AND ENVIRONMENTAL MILESTONES LONG-TERM WASTE MANAGEMENT TECHNOLOGY

AIRBORNE WASTE

FISCAL YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990-2000
PROGRAM SCHEDULES											
• DOUBLE LIFE OF ACID SERVICE FILTERS	▽										
• DOUBLE LIFE OF FIRST STAGE AND GLOVE BOX FILTERS				▽							
• COMPLETE C-14 AND H-3 IMMOBILIZATION TECHNOLOGY			▽								
• DEMONSTRATE INTEGRATED H-3 SEPARATION PILOT PLANT	▽										
• COMPLETE DEMONSTRATION OF H-3 IMMOBILIZATION IN CONCRETE POLYMER		▽									
• COMPLETE INTEGRATED OFF-GAS FACILITY											2000 ▽
EH & S COORDINATION & MANAGEMENT											
• NEPA ACTIVITIES											
– INTEGRATED OFF-GAS FACILITY										DEIS ▽	1990 ▽ FEIS
• SAFETY ANALYSIS REPORT								▽ PSAR			1990 ▽ FSAR
– INTEGRATED OFF-GAS FACILITY											
CRITERIA AND STANDARDS											
• EPA NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (Kr-85, C-14, H-3, Ar-41)			▽								

△ SCHEDULED START ▽ SCHEDULED COMPLETION

TABLE IV-3
COORDINATED TECHNOLOGY AND ENVIRONMENTAL MILESTONES
LONG-TERM WASTE MANAGEMENT TECHNOLOGY

HIGH-LEVEL WASTE

FISCAL YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990-2000
PROGRAM SCHEDULES											
• MATERIALS CHARACTERIZATION CENTER (BNWL) FULLY OPERATIONAL		▽									
• COMPLETE SCREENING & SELECTION OF ALTERNATIVE WASTE FORMS FOR SR PROCESS				▽							
• SELECT ALTERNATIVE WASTE FORMS FOR ENGINEERING DEVELOPMENT				▽							
• COMPLETE PROCESS & EQUIPMENT DEVELOPMENT REQUIRED TO INITIATE CONSTRUCTION OF DWPF FOR SR HLW		▽									
• ISSUE FINAL TEST PLAN FOR DEMONSTRATION OF ENGINEERED IMPROVEMENTS TO RL WASTE TANKS			▽								
• RL WASTE TREATMENT FACILITY										CONSTRUCTION △	
• ID WASTE TREATMENT FACILITY											CONSTRUCTION 1993 △
• SR DEFENSE WASTE PROCESSING FACILITY (DWPF)											
– CONSTRUCTION				△						▽	
– OPERATIONS											2000 △
– WASTE FORM FINAL ASSESSMENT AND SELECTION OF PREFERRED FORM					▽						
EH & S COORDINATION & MANAGEMENT											
• NEPA ACTIVITIES											
– WASTE MANAGEMENT NEPA PLAN	▽										
– RL											
• PEIS		DPEIS ▽	FPEIS ▽								
• IDENTIFY REFERENCE ALTERNATIVE AS BASIS FOR PREPARING PROJECT SPECIFIC EIS						▽					
• WASTE TREATMENT FACILITY							DEIS ▽	FEIS ▽			
– ID											
• PEIS		FPEIS ▽									
• RECOMMEND LONG-TERM DISPOSITION ALTERNATIVES AS BASIS FOR PREPARING PROJECT SPECIFIC EIS				▽							
• WASTE TREATMENT FACILITY											
DEIS											2001 ▽
FEIS											2002 ▽
• WASTE FORM NEPA REVIEW				▽							
– SR DEFENSE WASTE PROCESSING FACILITY		DEIS ▽	FEIS ▽								
• SAFETY ANALYSIS REPORT											
– RL WASTE TREATMENT FACILITY									PSAR ▽		
– ID WASTE TREATMENT FACILITY											PSAR 1991 ▽
– SR DEFENSE WASTE PROCESSING FACILITIES	PSAR ▽									PSAR ▽	
CRITERIA AND STANDARDS											
• EPA HLW STANDARD		NUMERICAL ▽									
• EPA NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (Kr-85, C-14, H-3, Ar-41)			▽								
• EPA HAZARDOUS WASTE STANDARD	▽										

△ SCHEDULED START ▽ SCHEDULED COMPLETION

TABLE IV-4
COORDINATED TECHNOLOGY AND ENVIRONMENTAL MILESTONES LONG-TERM WASTE MANAGEMENT TECHNOLOGY

LOW-LEVEL WASTE

FISCAL YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990-2000
PROGRAM SCHEDULES											
• SELECT AND BEGIN DEMONSTRATION OF FIRST ALTERNATE DISPOSAL METHOD		△									
• ISSUE FINAL REPORT ON DEMONSTRATION OF INTERMEDIATE DEPTH DISPOSAL				▽							
• ISSUE FINAL REPORTS ON SLB TECHNOLOGY FIELD TESTS AT ORNL AND LASL			▽								
• COMPLETE DEMONSTRATION OF ADVANCED TREATMENT TECHNOLOGY						▽					
• ISSUE DOE FINAL OPERATING CRITERIA	▽										
• ISSUE DRAFT CRITERIA FOR SITE SELECTION, WASTE FORM AND DECOMMISSIONING		▽									
EH & S COORDINATION & MANAGEMENT											
• NEPA ACTIVITIES											
– WASTE MANAGEMENT NEPA PLAN	▽										
CRITERIA AND STANDARDS											
• EPA LLW STANDARD				▽							

△ SCHEDULED START ▽ SCHEDULED COMPLETION

FIGURE IV-5
COORDINATED TECHNOLOGY AND ENVIRONMENTAL MILESTONES
LONG-TERM WASTE MANAGEMENT TECHNOLOGY

TRANSURANIC WASTE

FISCAL YEAR	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990-2000
PROGRAM SCHEDULES											
• PROVIDE BASIS FOR POLICY DECISION ON ID BURIED TRU WASTES		▽									
• TECHNOLOGY ANALYSIS FOR INSTRUMENTATION AND RETRIEVAL AND EXHUMATION		▽									
• PUBLISH ENGINEERING STUDY OF REMOVAL OF RL STORED TRU WASTE			▽								
• INCINERATION & DECONTAMINATION TECHNOLOGY DEMONSTRATED						▽					
• COMPLETE DEMONSTRATION OF INTEGRATED DECONTAMINATION SYSTEM FOR METALLIC TRU WASTE			▽								
• COMPLETE IMMOBILIZATION DEMONSTRATION WITH ACTUAL WASTE						▽					
• TRU WASTE TREATMENT FACILITY (TWTF)											
– DESIGN		TITLE I ▽	TITLE II △		TITLE II ▽						
– COMPLETE STARTUP & TESTING ON REEDY CREEK DEMONSTRATION PLANT			▽								
– CONSTRUCTION			△						▽		
– OPERATIONS										▽	
• WIPP SITE & DESIGN VERIFICATION				▽							
EH & S COORDINATION & MANAGEMENT											
• NEPA ACTIVITIES											
– WASTE MANAGEMENT NEPA PLAN	▽										
– SITE EIS's FOR STORED & BURIED TRU WASTE											
• INEL (SEPARATE EIS'S)		▽		▽							
• SAVANNAH RIVER (SEPARATE EIS'S CONSIDERED)				▽							
• RICHLAND				▽							
• LOS ALAMOS					▽						
• OAK RIDGE						▽					
– ISSUE DPEIS FOR RL HLW/TRU			▽								
– TWTF PROJECT SPECIFIC FEIS		▽									
• SAFETY ANALYSIS REPORT											
– TWTF			PSAR ▽							PSAR ▽	
CRITERIA AND STANDARDS											
• EPA HLW – TRU WASTE DISPOSAL STANDARD		▽ NUMERICAL									
LICENSING AND REGULATIONS											
• NRC REGULATION FOR THE DISPOSAL OF HLW (TRU)		▽									

△ SCHEDULED START ▽ SCHEDULED COMPLETION

Figure IV-6
SCHEDULE OF SPECIFIC EH&S REQUIREMENTS

EH&S REQUIREMENTS	RESPONSIBLE ORGANIZATION[1]	1980	1981	1982	1983	1984	1985	1986	1987	1988-2000
DWM 1.1	OWM (ESE)	△ - - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
1.2	OHER (OWM)	△ - - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
1.3	OWM (ESE, TAD, OES)		△	RL,SR				▽ RL		SR ▽ 2Q'88
DWM 2.1	OWM (NAD)		▽ SR					▽ RL		INEL 2Q'91
2.2	OWM (OHER, ESE, NAD)					▽ SR		▽ RL, INEL		
2.3	OWM (EV, NRC, EPA)		△	▽ IMPLEMENT AND MODIFY PLAN			- - -	- - -	- - -	- - -
DWM 3.1	OWM (OHER, OES, NAD, TAD)		▽ INEL			▽ OTHER SITES				
DWM 4.1	OWM (EV, NRC, EPA)		NWMP ▽	▽ IMPLEMENTATION PLAN		- - -	- - -	- - -	- - -	△ 1997 REPOSITORY OPERATION
4.2	OWM (EV, NRC)					▽ CRITERIA				
DWM 5.1	OWM			SEE COMMERCIAL WASTE MANAGEMENT EDP						

△ Scheduled Start

▽ Scheduled Completion

-------- Continued Activity

1. Lead Role Organization(s) are identified first. Parentheses identify supporting or coordinating organizations.

2. Periodic update.

Figure IV-6 (Cont.)

SCHEDULE OF SPECIFIC EH&S REQUIREMENTS

EH&S REQUIREMENTS	RESPONSIBLE[1] ORGANIZATION	FISCAL YEAR 1980	1981	1982	1983	1984	1985	1986	1987	1988-2000
DWM 6.1	OWM (OES, ESE, TAD)	△ - - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
6.2	OWM (OES, ESE)	△ - - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
6.3	OWM (OES)	△ - - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
DWM 7.1	OHER (OWM)	△ - - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
7.2	OHER (OWM)	△ - - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -
7.3	OWM (OES, OHER)	△		▽ ORNL HYDROFRACTURE			▽ DEMONSTRATE ADVANCED TECHNOLOGY		▽ STABILIZE SITES	
DWM 8.1	OWM (ESE, NRC)	△			▽					
8.2	OHER (OWM, ESE)	△			▽					
8.3	OWM (OES, OHER)	△	▽	▽						
DWM 9.1	OES (OWM, EPA, NIOSH)	△ EVALUATE	▽							
9.2	OHER (OES)		△					▽[2]		
9.3	OES (ESE, OHER)				▽	- - -	- - -	- - -	- - -	- - -
9.4	OWM (ESE, OES)		△ - - -	- - -	- - -	- - -	- - -	- - -	- - -	- - -

△ Scheduled Start

▽ Scheduled Completion

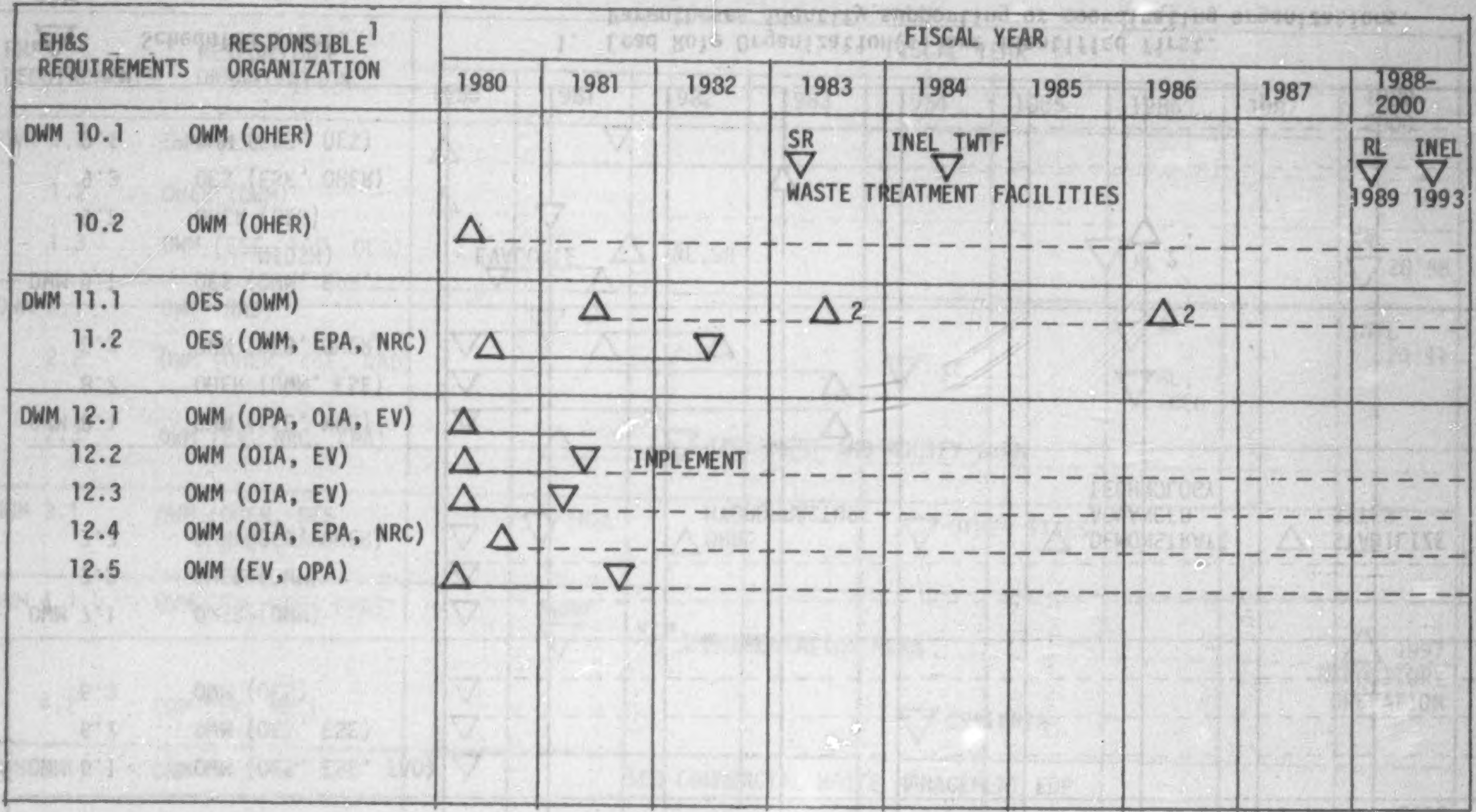
-------- Continued Activity

1. Lead Role Organization(s) are identified first. Parentheses identify supporting or coordinating organizations.

2. Periodic update.

Figure IV-6 (Cont.)

SCHEDULE OF SPECIFIC EH&S REQUIREMENTS



△ Scheduled Start
▽ Scheduled Completion
-------- Continued Activity

1. Lead Role Organization(s) are identified first. Parentheses identify supporting or coordinating organizations.

2. Periodic update.

Table IV-1

STRATEGY FOR IMPLEMENTING EH&S REQUIREMENTS FOR THE DEFENSE WASTE MANAGEMENT PROGRAM

1.1 Evaluate and verify adequacy of methods for early detection and measurement of radioactive materials that could escape from storage sites and facilities.

Strategy: The Office of Nuclear Waste Management (OWM) will continue to exercise primary responsibilities for continued updating of the site capabilities to detect and measure radioactivity escaping from facilities and operations. The Environmental and Safety Engineering Division (ESE) will provide technical assistance in defining current state-of-the-art of methods and techniques.

1.2 Continue to update estimates of dose to people via all logical exposure pathways for future storage/operations and concepts.

Strategy: As ongoing OHER research improves the data base for the chemical-physical behavior of radionuclides, the data will be included in updated dose estimates. The OWM will assure that currently used calculational methods for radionuclide transport in environmental media will continue to be updated as new information becomes available.

1.3 Assess, develop and test methods and processes for the reduction of risks by reducing the volumes of waste and conversion to stable forms acceptable for interim storage but compatible with long-term storage and eventual disposal requirements.

Strategy: The OWM continues to develop processes and techniques to reduce the volume of HLW generated in the chemical processing and other facilities, and to improve designs, instrumentation, and monitoring of HLW tanks. Improved HLW storage facilities at Savannah River and Hanford are expected to be in place by FY1982. Efforts to minimize liquids in HLW salt cakes (in old single-shell tanks) in storage at Richland will be continued by OWM. Coordination with EV (OES, OHER, NAD) will continue as appropriate.

2.1 Develop and test waste forms and encapsulants to determine their integrity and suitability for interim and long-term storage in alternative environments.

Strategy: Programs at SRP, INEL and Hanford will continue to develop waste forms for the waste treatment processes under development at all three sites for each of their respective wastes. The selection of alternative waste forms for engineering development is scheduled to be completed by FY1985. Process selection at each of the three sites (RL, INEL, SRP) will be coordinated in accordance with the NEPA process (EISs). EV will evaluate the need to publish an ERD at the decision milestones for process selection. Initial facility design to treat the Savannah River wastes is under way.

2.2 Assess the various alternatives of waste form and disposition environments to determine acceptable risks to the health and safety of workers and the public.

Strategy: An element of the decision on process selection will be the evaluation of the health and safety risks for the various HLW forms. OWM has in progress programs for development of the technology for waste forms which will be guided by the need to control the radioactive risks to the workers and the public. An ERD will help formulate the EV position on acceptability as part of the coordination effort between EV and OWM. The NEPA documentation process will incorporate an evaluation of the cost/benefits of the possible alternatives. Waste form decisions for SRP, INEL, and RL wastes are expected to be made in FY1984, FY1986 and FY1986, respectively.

2.3 Develop a plan for the long-term storage/disposition of defense waste treatment facility product in a suitable environment.

Strategy: The OWM will initiate the effort to identify and evaluate how the DOE will handle the treated waste from its planned HLW treatment facilities. The first such facility is expected to be at Savannah River with construction scheduled to start in FY1983. The programmatic Environmental Impact Statement (SRP) (November 1979) addresses the alternative processes for the handling of these wastes but the final disposition of the treated waste is yet to be addressed.

The OWM is currently preparing the National Plan for Radioactive Waste Management which President Carter called for in his February 12, 1980, announcement. The National Plan will include the disposition of defense HLW and TRU waste, probably placing the defense waste in a commercial repository (earliest possible date is 1997) in accordance with President Carter's Program for Radioactive Waste Management, February 1980. Other societal and institutional (Congress and state and local governments) considerations will have to be evaluated and incorporated in the plan. The State Planning Council will also play a role commensurate with its stated planning functions. Since the HLW repository is subject to NRC licensing, the plan should identify the schedules and milestones involved in the licensing process.

3.1 Develop criteria for determining the kinds of TRU waste, if any, that should be exhumed and processed, and what waste forms are acceptable for storage. This requires the reexamination (currently ongoing) of the 10 nCi/g value as the criteria for TRU retrievable storage.

Strategy: The OWM target date for a decision on exhumation of buried TRU waste at INEL is in FY1981. The demonstration of exhumation of buried TRU waste has been an ongoing program at INEL. Efforts to support a decision have involved all sites concerned (SRP, Hanford, INEL, Los Alamos, Oak Ridge) and are in varying stages of completion. The principal vehicle will be the NEPA process with draft and final EIS documentation for each of the installations on a schedule shown in Figure IV-5. The DOE and the public via the NEPA process will provide the basis for the final decision. The OWM will also consider the efforts of EPA in developing TRU waste disposal standards, and will also include in its considerations any repository acceptance criteria established or to be established by NRC in the event that DOE TRU waste would be placed in a licensed commercial waste repository.

ERDs will be prepared to assist the ASEV on decisions regarding exhumation at INEL as well as other sites.

4.1 Develop a plan for the long-term disposition of defense TRU wastes placed or to be placed in 20-year retrievable storage in a suitable environment.

Strategy: If the WIPP is cancelled as proposed by the President, alternate plans will be needed for the disposition of the defense TRU waste currently held and to be held (treated or untreated) in 20-year retrievable storage. The OWM will reevaluate the available alternatives in conjunction with the efforts in the Commercial Waste Management Program to provide an acceptable commercial waste repository. With the NRC licensing of a commercial repository, the OWM will coordinate the development of its plan with the development of licensing requirements and criteria for TRU waste acceptance at a commercial repository. Waste form acceptance criteria (NRC) should be coordinated with the TRU treatment and waste form development technology. The plan for TRU waste should incorporate the schedules for repository licensing and the schedules for the development of capability at all sites for exhumation, treatment (volume reduction, etc.) and packaging.

4.2 Develop treatment technology to place TRU waste in a form acceptable for long-term storage and/or to meet repository acceptance criteria.

Strategy: OWM will need to develop a TRU waste form acceptable by a licensed repository if defense TRU wastes are to be received at a commercial waste repository. (The earliest possible date for an operating repository is 1997.) OWM will have to coordinate its efforts with NRC. The timing is somewhat critical since the INEL TRU Waste Treatment Facility is presently scheduled to be constructed starting in FY1984.

5.1.1 Confirm the containment potential of the geologic formations of candidate sites.

5.1.2 Determine the effects of radiation on the integrity of geologic formations.

5.1.3 Determine the thermal effects on the integrity of geologic formations.

5.1.4 Improve and verify modeling of the transport and migration of radionuclides in geologic formations (i.e., identify, define mechanics and interactions and evaluate the pathways to man).

5.1.5 Develop a system for maintaining records of the kinds, quantities and exact locations of wastes that are placed in a repository.

5.1.6 Develop site acceptance and waste form criteria for geologic disposal.

5.1.7 Develop and test rock-mass drill-hole sealing methods and materials to provide repository seals which will not leak or be permeable.

Strategy: The study of and provisions for a repository for defense HLW are not a part of the current defense waste management program. However, terminal isolation (repository) is a major element of the Commercial Waste Management Program in which the requirements are addressed. The strategy here is to utilize, to the extent possible, the terminal isolation efforts conducted to satisfy the needs of the CWM program if defense HLW is to be placed in a commercial repository. In the event defense wastes are placed in a commercial repository, the same requirements would essentially prevail to maintain the isolation of wastes from the biosphere. The integration of the DWM and CWM programs in respect to a licensed commercial repository should be planned and scheduled in the National Waste Management Plan now under development.

6.1 Determine the potential for accidents at DWM facilities including natural disasters, criticalities, explosions and fires.

Strategy: OWM staff, field office personnel, Division of Operational and Environmental Safety (OES), EV, Technical Assessments Division (TAD), EV, Environmental and Safety Engineering Division (ESE), EV, will continue to review possible accident scenarios for waste management facility and operations. Reviews include SAR's, the vulnerability of current and future facilities to natural phenomena such as hurricanes, tornadoes, earthquakes, and other potential accidents such as unplanned criticality, explosions, airplane crashes and fires. These activities have been incorporated in the documentation for the NEPA process. OES, ESE and other EV organizations will continue to provide EH&S research and development data and criteria and requirements to OWM, who in turn will adjust or modify operations to achieve improvements in minimizing risks. OWM will continue to stress the importance of dissemination of information of an EH&S nature gained from experience at the various installations.

6.2 Identify and study sources of radioactive materials and probable mechanisms that could cause serious exposure and contamination conditions should accidents occur.

Strategy: The DOE field offices will continue reviews of the sources of radioactive materials that may be released in accident scenarios. If this continuing review discovers a potential for unacceptable exposure, mitigating measures will be planned to preclude or minimize radiation dose. OES, ESE (EV) will provide assistance as required in evaluating the potential risks and the resolution of the problem.

6.3 Develop and review health protection and emergency action plans for implementation under accident conditions of various degrees of severity.

Strategy: Each of the DOE facilities and operations should have emergency plans in accordance with DOE Directives. OES will continue to review the implementation of these activities. The field offices will continue to update existing emergency plans and provide the means for execution in the event such measures are required.

7.1 Continue to update dose estimates through the determination and use of knowledge of the physical and chemical forms of radionuclides released, dispersion in the atmosphere, transport in groundwater and surface water, and concentration in food chains.

Strategy: As the ongoing OHER research program improves the data base on the chemical/physical behavior of radionuclides, the data will be included in dose estimates to individuals in these waste facilities and operations. OWM will assure that currently used calculational methods for radionuclide transport in environmental media will continue to be updated as additional data are available.

7.2 Continue to update knowledge and assessments of ecological cycling of radioactive pollutants and potential exposure pathways of released radioisotopes to man.

Strategy: The DOE contractor laboratories and selected off-site contractors under the direction of OHER (EV) will continue ecological research and pollution characterization and monitoring efforts to increase knowledge of the source-term concentration and nature of radioactive pollutants entering the environment and the resulting transport, transformations, and uptake in plants, animals and the environment. OWM will use the information obtained to develop and upgrade models for determing ecological cycling and potential exposure pathways to man of released radioactive pollutants.

7.3 Develop and assess improved methods for storage of low-level defense wastes.

Strategy: The OWM through the DOE field offices will continue its program to upgrade the low-level waste disposal facilities and practices. These efforts include demonstration of disposal technology, volume reduction and long-term stabilization of existing burial grounds. The final DOE operating criteria for low-level waste will be coordinated with ASEV and others and will be issued in 1981. An ERD on the long-term stabilization of burial grounds will be developed by ASEV but coordinated with OWM in the usual manner. The development of DOE criteria will recognize the EPA effort to issue low-level waste standards. NRC assessing and licensing of new commercial sites will be reviewed to determine what impact, if any, there is on DOE facilities and operations.

8.1 The environmental control technology aspects of collection, containment, storage and disposal of airborne radioactive wastes will be studied and evaluated to derive an effective separation and storage methodology to satisfy both interim and long-term waste operations requirements.

Strategy: Efforts are under way in the OWM program to complete the technology for immobilization of gaseous wastes (kr-85, C-14, H-3, iodine isotopes). In the event that reduced effluent levels must be met and facilities modified, it is tentatively planned that long-lived wastes (e.g., carbon-14 and iodine-129) collected from gaseous waste streams will be eventually accommodated in a geologic repository. Interim engineered surface or dry-well storage is also planned for shorter-lived components (e.g., tritium and krypton-85) until they are substantially decayed. In this scenario, the DOE OWM program in conjunction with ESE would be coordinated with NRC so that acceptance criteria at the repository are met.

8.2 Dose estimates and required measurements and monitoring should be conducted to obtain reliable estimates of occupational exposure risks and public dose before and after separation and storage of airborne wastes are initiated.

Strategy: OWM in conjunction with OHER and ESE(EV) will continue to evaluate cost/benefit analyses to determine if containment, packaging and storage of gaseous waste is the appropriate strategy to follow.

8.3 Program strategy and planning is needed to identify the disposition of gaseous waste that is collected and stored.

Strategy: OWM will identify the strategies and formulate a plan to effect the disposition of these collected gaseous wastes. In the event that a commercial waste repository will be used, it will be necessary to coordinate activities (form, container, etc.) with NRC for acceptability at a licensed repository and with other appropriate regulatory bodies. OES and OHER should provide assistance to OWM in the development of the plan. This requirement should be a part of the National Waste Management Plan and the Waste Management Implementation Plan.

9.1 Survey DOE waste management facilities and operations to identify and characterize hazardous wastes utilized and/or generated.

Strategy: OWM, through its appropriate field offices, will initiate the survey for hazardous materials in the waste management systems. EV(OES, OHER) will identify those materials classified as hazardous including form, concentrations, etc. Identified chemicals and operations should be cross-checked with regulations associated with the Occupational Safety and Health Act, Toxic Substances Control Act, Resource Conservation and Recovery Act and other evolving requirements (see Appendix A).

9.2 Reevaluate the potential for exposures to hazardous chemicals and determine the health (genetic) risks.

Strategy: Field office staffs will reevaluate the potential for exposures to hazardous chemicals in DWM facilities and operations. With OES participation, OHER will estimate the health and genetic risks for chemicals unique to these waste operations, as new information becomes available and will identify any further specific information needs to complete the evaluation. For potentially toxic chemicals in DWM facilities for which no TLVs exist, assistance will be requested from other agencies having expertise or jurisdiction (NIOSH, EPA, etc.).

9.3 Reevaluate the capability to identify, characterize and monitor hazardous concentrations of toxic chemicals in DWM facilities and environs where a significant risk is present.

Strategy: OES with the support of ESE(EV) and OHER(EV) will evaluate the capability to detect, characterize and monitor the toxic chemicals in waste operations which represent potential risks to workers and others. Corrective actions, if any, will be recommended to OWM. EPA and other agencies will be consulted as appropriate.

9.4 Determine and implement control techniques and procedures to comply with current and emerging standards.

Strategy: Once hazardous materials have been identified, the potential for exposure has been determined and the capability for monitoring has been evaluated, OWM will determine the control procedures and/or facility modifications and replacements required to reduce the risks to an acceptable level. ESE should assist OWM in assessing proposed control techniques. OES should assist in establishing and complying with procedures designed to alleviate the problem.

10.1 Conduct baseline ecological studies at new DWM storage and waste treatment sites to provide valid assessments of the effects of future facility construction and operation activities.

Strategy: The field offices involved in the DWM program will continue to characterize the ecological conditions at DOE sites. This baseline information will be used to predict environmental impacts for additional facilities and operations. OHER will provide assistance and the framework for these evaluations.

10.2 Establish and conduct ecological monitoring and analysis programs to determine the effects of operating facilities on ecosystems in the environment surrounding DWM facilities.

Strategy: OHER will provide guidance and assistance to OWM in developing programs for instituting, upgrading and replacing the means of monitoring ecological impacts from waste operations. OWM will implement improvements and will continue to encourage ecological studies at the established Environmental Research Parks at INEL, SRP, Hanford and LASL.

11.1 Develop criteria for buffer zones and for compatible use (Government and private) of coterminous lands.

Strategy: OES with OWM and Defense Programs will continue to assess the need for the dedication of land at DWM sites for buffer zones to protect the health and safety of the public. The assessments will form the basis for establishing updated or new criteria. Coordination will be required with other technology programs using sites at which waste management activities are conducted. Site managers will be part of that coordinated effort.

11.2 Develop long-range objectives, criteria and plans for the use and/or disposition of lands not required for DWM facilities.

Strategy: OES will evaluate with OWM and Defense Programs the land needs for the DWM program. The evaluation will be developed into a plan for use or disposition of the land consistent with Defense Programs priorities. In the case of disposition, possible uses for the land (agriculture, grazing, industrial, etc.) will be identified. OWM will initiate efforts to identify and characterize land which, because of its contamination, may be classified as "dedicated land." Criteria for dedicated land should result from these efforts.

12.1 Determine, through sampling, questionnaires, and analysis of public documents the public's majority opinion and perception of what constitutes an acceptable risk relative to long-term storage/disposal options and other major program considerations.

Strategy: The Office of Nuclear Waste Management is taking a lead role in developing a program to sample the public perception, with support from the Office of Public Affairs and the Office of Intergovernmental Affairs. The President's Policy Statement on Radioactive Waste Management of February 12, 1980 provides a basis for this activity which is also being incorporated in the draft National Plan for Radioactive Waste Management. Similar projects to obtain public involvement are being developed for the individual programs, e.g., LLW management. Public input through these potential techniques plus public involvement through NEPA and the regulatory process will be a consideration for major program decisions and commitments.

12.2 Improve procedures for obtaining the public input so that it can be considered in the decision-making process for major commitments such as (1) the selection of waste storage/disposal; (2) institutional arrangements for long-term storage/disposal management; and (3) decisions on irreversible actions.

Strategy: Using the IRG report and the President's Policy Statement on Radioactive Waste Management as guidance, OWM is developing and implementing a program plan which has as its objective the means to obtain public input on the significant decisions to be made in the DWM program. This program will have support from the Office of Intergovernmental Affairs, and will be coordinated with ASEV and other appropriate organizations. The plan will include the mechanism, timing and particular activities to obtain input for each significant decision.

12.3 Determine the best mechanisms for long-term surveillance and safeguarding of defense waste and waste isolation sites.

Strategy: At the present time all of the DWM wastes (facilities, etc.) are under the control of the Federal government, and are situated on Federal property. (An exception might be some low-level waste sent to commercial burial sites.) All planning being carried out in the DWM program is based on continual Federal ownership of waste sites on Federal lands. The State Planning Council will undoubtedly consider the institutional interests, mechanisms and responsibilities relative to its proposed planning function. Through this mechanism, state (and local) inputs can be provided in consideration of long-term surveillance of wastes, waste sites and facilities. In addition, the determination will evolve through the processes of establishing standards and regulations (EPA, NRC). OWM in its responsibilities for the DWM program will be assisted by OIA and EV as appropriate.

12.4 Work out jurisdictional authority between Federal, state, and local agencies for prospective waste management activities.

Strategy: The President's Program on Radioactive Waste Management provides the basis for involving the state, local government and other institutions in the decision-making process for waste management activities. The State Planning Council (see President Carter's Program on Radioactive Waste Management) will, among other activities, recommend mechanisms, including the consultation and concurrence process designed to achieve Federal, state and local agreements; work on development of waste management plans to ensure that they address the affected states and local areas; advise on all aspects of siting and licensing of facilities for storage and disposal of nuclear wastes; and advise on proposed Federal regulations, standards and criteria. The OWM will conduct this effort with assistance from OIA as appropriate and coordinate its efforts with EPA and NRC.

12.5 Improve the public's perceptions and knowledge of the DWM Program.

Strategy: A combined effort of the OWM, ASEV, OPA will review and evaluate the accomplishments of the present methods of keeping the public informed and increasing the perception of the public in regard to waste

management activities, decisions, risks, etc. If the results of this evaluation warrant it, other alternatives should be identified and evaluated, and the most beneficial alternative should be considered for implementation, with a detailed plan for its implementation. This strategy should be carried out in the near term.

REFERENCES

1. Nuclear Waste Management Program Summary Document, DOE/NE-008, FY1981, March 1980, U.S. Dept. of Energy.

2. Defense Waste Management Multi-Year Program Plan, FY1981, March 1980, U.S. Dept. of Energy.

3. Final Environmental Impact Statement, Waste Management Operations, Hanford Reservation, December 1975, U.S. ERDA.

4. Final Environmental Impact Statement, Waste Management Operations, Savannah River Plant, September 1977, U.S. ERDA.

5. Final Environmental Impact Statement, Waste Management Operations, Idaho National Engineering Laboratory, September 1977, U.S. ERDA.

6. Project Environmental Plan for TRU Waste Treatment Facility, October 11, 1979, U.S. Dept. of Energy.

7. Project Environmental Plan for the Defense Waste Processing Facility, U.S. Dept. of Energy.

8. Project Environmental Plan, Additional High-Level Waste Storage Facilities, Savannah River Plant, U.S. Dept. of Energy.

9. Project Environmental Plan for the New Waste Calciner Facility, U.S. Dept. of Energy.

10. Draft Report of the Subgroup on DOE Waste - Special Issues of the Interagency Review Group on Nuclear Waste Management, August 1978.

11. Report to the President by the Interagency Review Group on Nuclear Waste Management, April 1979.

12. The President's Program on Radioactive Waste Management, The White House, February 12, 1980.

13. Final Environmental Impact Statement, Long-Term Management of Defense High-Level Waste, SRP, DOE/EIS-0023, Aiken, S.C., U.S. Dept. of Energy, November 29, 1979.

DEFENSE WASTE MANAGEMENT
APPENDIX A
APPLICABLE EH&S REGULATIONS

LEGISLATION/DIRECTIVES	APPLICABLE SECTION(S) OF CFR	APPLICABLE POLLUTANTS OR RESIDUALS	STANDARDS AND REGULATIONS CURRENTLY APPLICABLE	POTENTIAL FUTURE APPLICABLE STANDARDS AND REGULATIONS
National Environmental Policy Act (42 USC 4341)	40 CFR 1502	General	Preparation of Environmental Assessments and Environmental Impact Statements.	
Atomic Energy Act, as Amended (42 USC 2001) and Energy Reorganization Act of 1974 (42 USC 5801)	10 CFR 20	Radiation and Radioactive Waste	Standards for radiation protection including air and water concentration limits for radioactive isotopes; maximum permissible doses to occupational and offsite personnel; and, disposal requirements for radioactive wastes.	Radiation dose limits may be reduced for occupational personnel by EPA based on transferred authority from the Federal Radiation Council.
	10 CFR 30	Radioactive Waste	Rules for licensing of byproduct material	
	10 CFR 50	Radiation		Although DWM plants are currently not licensed by the NRC similar provisions as outlined in 10 CFR 50 Appendix 1 for limiting radioactive releases during operation as low as reasonably achievable may be applied.
	10 CFR 71	Radioactive Material	Requirements for handling and transporting large quantities of radioactive material.	
	10 CFR 40, 70	Radioactive Material	Licensing for Handling of Source and Special Nuclear Material. Not now applicable except for high-level waste long-term storage.	NRC licensing may be extended to other defense waste activities.
	10 CFR 73	General		Although DWM facilities are currently not planned to be licensed by NRC, similar physical security provisions as outlined in 10 CFR 73 may be applied.

Appendix A (Cont.)

APPLICABLE EH&S REGULATIONS

LEGISLATION / DIRECTIVES	APPLICABLE SECTION(S) OF CFR	APPLICABLE POLLUTANTS OR RESIDUALS	STANDARDS AND REGULATIONS CURRENTLY APPLICABLE	POTENTIAL FUTURE APPLICABLE STANDARDS AND REGULATIONS
Hazardous Materials Transportation Act (49 USC 1801)	49 CFR 170-178	Radioactive Materials	Provides guidance for limiting exposure of the public from transportation of radioactive materials and from transportation accidents.	
			Radiation Exposure Inventory	Establish data bank on transportation exposure due to radioactive material (under development for completion 1982)
			Control and minimize radiation exposure	DOT/NRC establishing a Federal/state/local relationship for shipment of radioactive material to minimize exposure. Expected completion 1980.
Occupational Safety & Health Act (29 USC 651)	29 CFR 1910	Ionizing Radiation	Occupational exposure limits for ionizing radiation (including x-rays) consistent with 10 CFR 20.	
		Toxic and Hazardous Substances	Occupational exposure limits for most airborne contaminants. Includes manganese, cadmium, mercury, and nitrogen compounds.	
		Rock Salt Dust		May be identified as an occupational hazard
	29 CFR 1990	Carcinogens	Reduced exposure to lowest feasible.	Could apply to any pollutant identified as a carcinogen.
	None	All inclusive	DOE Environmental, Safety and Health Manual (order 5480) provides guidance for the operation of all DOE operated facilities.	May be modified to meet new requirements issued by other Federal agencies.

Appendix A (Cont.)

APPLICABLE EH&S REGULATIONS

LEGISLATION/DIRECTIVES	APPLICABLE SECTION(S) OF CFR	APPLICABLE POLLUTANTS OR RESIDUALS	STANDARDS AND REGULATIONS CURRENTLY APPLICABLE	POTENTIAL FUTURE APPLICABLE STANDARDS AND REGULATIONS
Resource Conservation and Recovery Act (42 USC 6901 et seq.)	40 CFR 250, 257	Solid Waste	Provides quidelines for the collection, transport, separation and disposal of hazardous substances (listed in 40 CFR 250.14). Radioactive waste exempted per section 1006 of the Act. Guidelines for the identification of hazardous waste include a toxicant extraction procedure that specifically addresses trace elements regulated under Section 141.11 of the Safe Drinking Water Act.	
	40 CFR 250	Hazardous Waste		Proposed standards require operators of hazardous waste treatment, storage and disposal facilities to maintain monitoring system to determine whether the facilities are, causing significant increase in ground water contamination or contamination of water in aeration zone. May be applicable to DWM facilities.
	40 CFR 122	Radioactive Waste	Provides quidlines for states underground injection programs. Requires operators of wells for injection of radioactive waste to obtain interim status until states program is effected.	
Toxic substances Control Act (TSCA) (15 USC 2601 et seq.)	40 CFR 710	Toxic and Hazardous Wastes	All products and byproducts (including waste) are subject to review.	TSCA provides a basis for future nonradioactive trace element regulatory action. This may include testing requirements to identify possible hazardous substances in products and byproducts. Also the disposal of potentially harmful chemical substances or mixtures is subject to review.

Appendix A (Cont.)

APPLICABLE EH&S REGULATIONS

LEGISLATION/DIRECTIVES	APPLICABLE SECTION(S) OF CFR	APPLICABLE POLLUTANTS OR RESIDUALS	STANDARDS AND REGULATIONS CURRENTLY APPLICABLE	POTENTIAL FUTURE APPLICABLE STANDARDS AND REGULATIONS
Clean Air Act, as Amended (43 USC 7401)	40 CFR 61	Radiation	Prescribes emission standards for stationary sources. Radionuclides are added to the list of hazardous air pollutants (Includes Kr-85, C-14, H-3, Pu-239, U-235, Ar-41).	National Emission Standards are to be developed for those radionuclides listed as hazardous air pollutants and proposed standards are expected to be published by 1983 under Section 112 of the CAA.
	40 CFR 50	General Air Pollutants	Provides primary and secondary ambient air quality standards for nitrogen dioxide and particulate matter.	National Ambient Air Quality Standards (NAAQS) may be applied to radiation releases in future.
	40 CFR 60	Radiation and Non-radioactive emissions (e.g., fugitive dust)	Prevent significant deterioration of air quality during construction and operational phases.	
	40 CFR 61	Airborne Carcinogens		EPA is to issue generic standards for control of carcinogenic organic chemicals listed under requirements of Section 112 of CAA.
Clean Water Act (CWA) (33 USC 1251)	40 CFR 116, 117	Liquid Effluents	Applicable substances and reportable quantities in list of hazardous substances[1]	Conventional pollutants must meet effluent limitations based on Best Conventional Pollutant Control Technology (BCT) by 1981. All pollutants other than toxic or conventional must meet effluent limitations based on Best Available Technology (BAT) by 1987; a waiver (defined by CWA) must meet effluent limitations based on Best Available Technology Economically Achievable (BATEA) by 1984.
	40 CFR 122, 125	Liquid Effluents	National Pollutant Discharge Elimination System (NPDES) effluent discharge permit for wastes not covered by Atomic Energy Act including thermal discharges.	
	33 CFR 153	Liquid Effluents	Provides restrictions for discharges into navigable waters or adjoining shorelines in quality endangering public health or welfare, fish, wildlife, shores or beaches (discharge limits controlled by "state of the art").	

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1. Guidelines for monitoring and analysis of pollutants are excluded. These may be found in the applicable CFR's (e.g., 40 CFR 146 test procedures for analysis of pollutants).

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Appendix A (Cont.)

APPLICABLE EH&S REGULATIONS

LEGISLATION/DIRECTIVES	APPLICABLE SECTION(S) OF CFR	APPLICABLE POLLUTANTS OR RESIDUALS	STANDARDS AND REGULATIONS CURRENTLY APPLICABLE	POTENTIAL FUTURE APPLICABLE STANDARDS AND REGULATIONS
Safe Drinking Water Act (42 USC 300)	40 CFR 141	Hazardous Water Pollutants	SDWA established maximum contaminant levels for inorganic chemicals which include cadmium, nitrates and radioactivity levels in community water systems.	
	40 CFR 146			EPA plans to issue regulations governing underground injection of toxic material into the groundwater.
	40 CFR 122	Radioactive Waste	Provides guidelines for states underground injection programs. Requires operators of wells for injection of radioactive waste to obtain interim status until states program is effected.	
Presidential Reorganization Plan No. 3 of 1970 (Environmental Protection Agency)	40 CFR 90	Population Radiation Exposure		Generally applicable environmental radiation protection standard of 25 mrem/year to an individual in the general population may be applied to DOE disposal facility if waste is from both defense and commercial sources.
		Radioactive Waste		The EPA high-level waste standard is expected to be published in March 1981. It will be numerical and will apply to high-level transuranic waste. The EPA low-level waste standard (and disposal) is under development. It is not expected to be completed until 1983.

Appendix A (Cont.)

APPLICABLE EH&S REGULATIONS

LEGISLATION/DIRECTIVES	APPLICABLE SECTION(S) OF CFR	APPLICABLE POLLUTANTS OR RESIDUALS	STANDARDS AND REGULATIONS CURRENTLY APPLICABLE	POTENTIAL FUTURE APPLICABLE STANDARDS AND REGULATIONS
Federal Land Policy and Management Act of 1976	43 CFR 1700-9299	Land Use Planning	Establishes public land policy and provides for the management, protection, development and enhancement of the public lands.	May need to assess land use to delineate present and future needs including decontamination and decommissioning.
Federal Mine Safety and Health Act of 1977		Noise, medical examinations, use of respiratory equipment, and respirable dust	Mandatory health standards for mine workers. Respirable dust standard is 2.0 mg/m^3 of air in the mine atmosphere during each work shift.	
Federal Mine Safety (Cont.)	30 CFR 717	Underground mining	General performance standard for underground coal mining and associated reclamation operations.	Regulation applies to coal mining but could extend to construction of underground waste repository.

APPENDIX B-1

SUMMARY OF ONGOING RESEARCH SUPPORTED BY NON-DOE FEDERAL AGENCIES (FY 1978)

Requirement Number[1]	Identifier Code[2]	Program Title/Description	Performing Organization	Sponsoring Agency	Impact Area[3]	R & D Category[3]
1.1	150294	Peer Review of High-Level Waste Site Suitability Criteria	TRW	NRC	7, 3, 6, 8	5.1, 5.2, 5.3 5.4, 5.5, 5.6 6.6, 7.2, 8.3
	150428	Mobility of Radioactive Waste Materials in Subsurface Migration by Particulate Transport	Georgia Institute of Technology	NRC	2, 4	1.3, 4.3
	150431	Subsurface Radar Profiling	Geo. Centers, Inc.	NRC	2, 4	1.3, 4.3
1.2	150327	Updating the Environmental Survey of the Uranium Fuel Cycle	NUS Corp.	NRC	3, 4, 5, 6	1.2, 3.5, 4.2 6.6, 7.3, 8.4
	NUREG/CR-0700	Preliminary Analysis of First Crop of Plants Grown in Seven Soils Uniformly Contaminated with Four Transuranic Elements Simultaneously	UCLA	NRC	4	4.4
1.3	120129	Radioactive Waste Disposal	TVA	TVA	3	7.2
	150134	Methodology Development for Waste Disposal Options	Sandia	NRC	2, 4, 5, 7	4.3, 6.6, 7.2
	150272	Evaluation of Scientific and Technical Aspects of Certain Problems Involving the Management of Radioactive Wastes	NAS	NRC	2, 3, 4, 5 6	2.1, 3.5, 5.4 5.5, 6.6, 7.2 8.1

1. Requirement number refers to E/H/S requirements given in Table III-1.
2. Code refers to numbers used in Inventory of Federal Energy Related Environmental and Safety Research for FY 1978 (in publication).
3. Impact Area and R & D Category numbers are those used in Appendix C, Taxonomy for EDP Concerns and Requirements.

APPENDIX B-1

SUMMARY OF ONGOING RESEARCH SUPPORTED BY NON-DOE FEDERAL AGENCIES (FY 1978)

Requirement Number	Identifier Code	Program Title/Description	Performing Organization	Sponsoring Agency	Impact Area	R & D Category
1.3 (Cont'd)	150322	Conference on High-Level Radioactive Solid Waste Forms	SCS Engineers	NRC	3, 5, 6, 7	1.2, 5.2, 6.6, 7.2
	150326	NRC Waste Management Contractors Conference	Coolfont Re-Creation	NRC	9	7.2, 8.3
	150440	Studies of the Corrosion of Nuclear Waste Containers	University of Arizona	NRC	3, 6	2.3, 4.3, 7.2
	EPA 520/6-78-005	Development and Application of a Risk Assessment Method for Radioactive Waste Management; Vol. 1: Generic Description of AMRAW-A Model	University of New Mexico	EPA	9	6.3
2.1	150134	Methodology Development for Waste Disposal Options	Sandia	NRC	2, 4, 5, 7	4.3, 6.6, 7.2
	150432	Evaluation of Relative Surface Properties of Alternate Nuclear Waste Encapsulants	University of Florida	NRC	3, 5	2.3, 7.2, 8.1
	150434	Durability of Crystalline Waste Forms and Their Natural Analog at Geologic Storage Conditions	Toledo University	NRC	3, 4, 5, 6	2.3, 7.2
	150435	Kinetics of Nuclear/Repository Interface Reactions	San Jose State University	NRC	4, 5, 6	1.2, 2.1, 2.3 7.3

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SUMMARY OF ONGOING RESEARCH SUPPORTED BY NON-DOE FEDERAL AGENCIES (FY 1978)

Requirement Number	Identifier Code	Program Title/Description	Performing Organization	Sponsoring Agency	Impact Area	R & D Category
2.1 (Cont'd)	150440	Studies of the Corrosion of Nuclear Waste Containers	University of Arizona	NRC	3, 6	2.3, 4.3, 7.2
2.2	150326	NRC Waste Management Contractors Conference	Coolfont Re-Creation	NRC	9	7.2, 8.3
2.3	150134	Methodology Development for Waste Disposal Options	Sandia	NRC	2, 4, 5, 7	4.3, 6.6, 7.2
	150272	Evaluation of Scientific and Technical Aspects of Certain Problems Involving the Management of Radioactive Wastes	NAS	NRC	2, 3, 4, 5 6	2.1, 3.5, 5.4 5.5, 6.6, 7.2, 8.1
	150322	Conference on High-Level Radioactive Solid Waste Forms	SCS Engineers	NRC	3, 5, 6, 7	1.2, 5.2, 6.6 7.2
	150327	Updating the Environmental Survey of the Uranium Fuel Cycle	NUS Corp.	NRC	3, 4, 5, 6	1.2, 3.5, 4.2 6.6, 7.3, 8.4
	150433	Nuclear Waste Option Assessment	Harvard University	NRC	4, 5, 6	3.5, 7.2, 6.3 8.1

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SUMMARY OF ONGOING RESEARCH SUPPORTED BY NON-DOE FEDERAL AGENCIES (FY 1978)

Requirement Number	Identifier Code	Program Title/Description	Performing Organization	Sponsoring Agency	Impact Area	R & D Category
3.1	150320	Compilation of the Radioactive Waste Disposal Classification System	Ford, Bacon and Davis Utah, Inc.	NRC	9, 3, 6	1.2, 4.2, 6.6 8.3, 8.5
	EPA 520/6-78-005	Development and Application of a Risk Assessment Method for Radioactive Waste Management	University of New Mexico	EPA	9	6.3
4.1	150134	Methodology Development for Waste Disposal Options	Sandia	NRC	2, 4, 5, 7	4.3, 6.6, 7.2
5.1.1	150291	Definition of Design Performance Criteria for a Radioactive Waste Repository	Analytical Sciences Laboratory	NRC	6, 5	2.1, 6.6, 7.2 8.1
	150427	Indirect Rock Mass Investigations	University of Arizona	NRC	6, 8	2.3, 6.6, 7.2 8.3
	150134	Methodology Development for Waste Disposal Options	Sandia	NRC	3,5,7,8	4.3, 6.6, 7.2

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SUMMARY OF ONGOING RESEARCH SUPPORTED BY NON-DOE FEDERAL AGENCIES (FY 1978)

Requirement Number	Identifier Code	Program Title/Description	Performing Organization	Sponsoring Agency	Impact Area	R & D Category
5.1.1 (Cont'd)	150441	Solubility of Uranite in Salt Brine	Harvard University	NRC	3, 4, 5, 6	1.2, 2.2, 4.3 7.2
5.1.2	150436	Thermal Conductivity of Minerals	Cornell University	NRC	4, 5, 6	1.3, 2.3, 7.2
5.1.3	150429	Thermal Stresses in Waste Disposal Systems	Iowa State University	NRC	4, 5, 9	2.3, 1.3, 7.2
	150435	Kinetics of Nuclear/Repository Interface Reactions	San Jose State University	NRC	4, 5, 6	1.2, 2.1, 2.3, 7.3
	150436	Thermal Conductivity of Minerals	Cornell University	NRC	4, 5, 6	1.3, 2.3, 7.2
5.1.4	54039	Low-Level Waste Hydrology	USGS	DOI	2, 3	2.1, 7.2
	54069	National Environmental Overview Program	USGS	DOI (USGS)	8, 7,	7.2, 2.3, 1.1
	150250	Risk Methodology for Waste Isolation in Deep Geologic Media	Sandia	NRC	3, 4, 5 6	3.5, 4.3, 6.6, 7.2, 8.1

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SUMMARY OF ONGOING RESEARCH SUPPORTED BY NON-DOE FEDERAL AGENCIES (FY 1978)

Requirement Number	Identifier Code	Program Title/Description	Performing Organization	Sponsoring Agency	Impact Area	R & D Category
5.1.4 (Cont'd)	150316	Dynamic Modeling of Geologic Processes	USGS	NRC	6, 9	2.3, 4.3, 7.2 8.1
	150430	Migration and Retention Data from Natural and Inadvertent Repositories	Stanford University	NRC	4, 5, 9	2.3, 1.3, 7.2
	150435	Kinetics of Nuclear/Repository Interface Reactions	San Jose State University	NRC	4, 5, 6	1.2, 2.1, 2.3 7.3
	150435	Thermal Conductivity of Minerals	Cornell University	NRC	4, 5, 6	1.3, 2.3, 7.2
	150438	Dating of Ground Water	University of Arizona	NRC	2, 4	1.3, 2.1, 4.1
5.1.5						
5.1.6	150291	Definition of Design Performance Criteria for a Radioactive Waste Repository	Analytical Sciences Laboratory	NRC	6, 5	2.1, 6.6, 7.2 B.1

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SUMMARY OF ONGOING RESEARCH SUPPORTED BY NON-DOE FEDERAL AGENCIES (FY 1978)

Requirement Number	Identifier Code	Program Title/Description	Performing Organization	Sponsoring Agency	Impact Area	R & D Category
5.1.6 (Cont'd)	150322	Conference on High-Level Radioactive Solid Waste Forms	SCS Engineers	NRC	3, 5, 6, 7	1.2, 5.2, 6.6 7.2
	150327	Updating the Environmental Survey of the Uranium Fuel Cycle	NUS Corp.	NRC	3, 4, 5, 6	1.2, 3.5, 4.2 6.6, 7.3, 8.4
	150427	Indirect Rock Mass Investigations	University of Arizona	NRC	6, 8	2.3, 6.6, 7.2 8.3
	150429	Thermal Stresses in Waste Disposal Systems	Iowa State University	NRC	4, 5, 9	2.3, 1.3, 7.2
	150435	Kinetics of Nuclear/Repository Interface Reactions	San Jose State University	NRC	4, 5, 6	1.2, 2.1, 2.3 7.3
	150436	Thermal Conductivity of Minerals	Cornell University	NRC	4, 5, 6	1.3, 2.3, 7.2
5.1.7	150437	Sealing Rock Masses	University of Arizona	NRC	4, 5	2.3, 7.2

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SUMMARY OF ONGOING RESEARCH SUPPORTED BY NON-DOE FEDERAL AGENCIES (FY 1978)

Requirement Number	Identifier Code	Program Title/Description	Performing Organization	Sponsoring Agency	Impact Area	R & D Category
6.1	159293	Site Suitability for Geological Storage or Disposal of High-Level Radioactive Waste	NAC	NRC	3, 6, 8	5.5, 6.6, 7.2 8.3
	150327	Updating the Environmental Survey of the Uranium Fuel Cycle	NUS Corp.	NRC	3, 4, 5 6	1.2, 3.5, 4.2 6.6, 7.3, 8.4
6.2	120129	Radioactive Waste Disposal	TVA	TVA	3	7.2
	150212	GESMO (Generic Environmental Impact Statement for Mixed Oxide Fuel) Waste Management	ANL	NRC	3, 5, 7, 8	5.1, 5.2, 5.5 6.6, 7.1, 7.2 8.1
	150320	Compilation of the Radioactive Waste Disposal Classification System	Ford, Bacon and Davis Utah, Inc.	NRC	9, 3, 6	1.2, 4.2, 6.6 8.3, 8.5
	150323	Environmental Impact Statement on the Sheffield Low-Level Waste Disposal Site	NUS Corp.	NRC	9	6.5
	150433	Nuclear Waste Option Assessment	Harvard University	NRC	4, 5, 6	3.5, 7.2, 6.3 8.1

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SUMMARY OF ONGOING RESEARCH SUPPORTED BY NON-DOE FEDERAL AGENCIES (FY 1978)

Requirement Number	Identifier Code	Program Title/Description	Performing Organization	Sponsoring Agency	Impact Area	R & D Category
6.3	150326	NRC Waste Management Contractors Conference	Coolfont Re-Creation	NRC	9	7.2, 8.3
7.1	54039	Low-Level Waste Hydrology	USGS	DOI	2, 3	2.1, 7.2
	150133	Evaluation of Isotope Migration--Water Chemistry at Shallow Land Burial Grounds	BNL	NRC	2, 4	2.1, 4.3
	150271	Study of Alternative Methods for the Disposal of Low-Level Wastes	Ford, Bacon, and Davis	NRC	2, 3, 4 5, 8	2.1, 3.4, 4.4 5.5, 7.1, 7.2 8.1
	150323	Environmental Impact Statement on the Sheffield Low-Level Waste Disposal Site	NUS Corp.	NRC	9	6.5

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SUMMARY OF ONGOING RESEARCH SUPPORTED BY NON-DOE FEDERAL AGENCIES (FY 1978)

Requirement Number	Identifier Code	Program Title/Description	Performing Organization	Sponsoring Agency	Impact Area	R & D Category
7.1 (Cont'd)	150327	Updating the Environmental Survey of the Uranium Fuel Cycle	NUS Corp.	NRC	3, 4, 5 6	1.2, 3.5, 4.2 6.6, 7.3, 8.4
	150428	Mobility of Radioactive Waste Materials in Subsurface Migration by Particulate Transport	Georgia Institute of Technology	NRC	2, 4	1.3, 4.3
	150431	Subsurface Radar Profiling	Geo. Centers, Inc.	NRC	2, 4	1.3, 4.3
	NUREG/CR-0700	Preliminary Analysis of First Crop of Plants Grown in Seven Soils Uniformly Contaminated with Four Transuranic Elements Simultaneously	UCLA	NRC	4	4.4
	NUREG/CR-0701	Biological Transport of Radionuclides at Low-Level Waste Storage Sites	UCLA	NRC	4	4.4
7.2	150133	Evaluation of Isotope Migration -- Water Chemistry at Shallow Land Burial Grounds	BNL	NRC	2, 4	2.1, 4.3
	150271	Study of Alternative Methods for the Disposal of Low-Level Wastes	Ford, Bacon, and Davis	NRC	2, 3, 4, 5 8	2.1, 3.4, 4.4 5,5, 7.1, 7.2 8.1
	150323	Environmental Impact Statement on the Sheffield Low-Level Waste Disposal Site	NUS Corp.	NRC	9	6.5
	150327	Updating the Environmental Survey of the Uranium Fuel Cycle	NUS Corp.	NRC	3, 4, 5, 6	1.2, 3.5, 4.2 6.6, 7.3, 8.4

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SUMMARY OF ONGOING RESEARCH SUPPORTED BY NON-DOE FEDERAL AGENCIES (FY 1978)

Requirement Number	Identifier Code	Program Title/Description	Performing Organization	Sponsoring Agency	Impact Area	R & D Category
7.3	150271	Study of Alternative Methods for the Disposal of Low-Level Wastes	Ford, Bacon, and Davis	NRC	2, 3, 4, 5, 8	2.1, 3.4, 4.4 5.5, 7.1, 7.2 8.1
	150326	NRC Waste Management Contractors Conference	Coolfont Re-Creation	NRC	9	7.2, 8.3
	EPA 520/6-78-005	Development and Application of a Risk Assessment Method for Radioactive Waste Management, Vol. 1	University of New Mexico	EPA	9	6.3
8.1	150132	Waste Management Parametric Study	ORNL	NRC	3, 7	6.3, 5.2, 7.1
	150188	Properties of Radioactive Wastes and Containers	BNL	NRC	6	7.2
	150292	Study to Determine the Country's Waste Disposal Needs Through the Year 2000	Teknekron Research Incorporated	NRC	3, 7, 8	1.2, 4.2, 5.2 6.1, 7.2
	150322	Conference on High-Level Radioactive Solid Waste Forms	SCS Engineers	NRC	3, 5, 6 7	1.2, 5.2, 6.6 7.2
	150326	NRC Waste Management Contractors Conference	Coolfont Re-Creation	NRC	9	7.2, 8.3

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SUMMARY OF ONGOING RESEARCH SUPPORTED BY NON-DOE FEDERAL AGENCIES (FY 1978)

Requirement Number	Identifier Code	Program Title/Description	Performing Organization	Sponsoring Agency	Impact Area	R & D Category
8.1 (Cont'd)	150327	Updating the Environmental Survey of the Uranium Fuel Cycle	NUS Corp.	NRC	3, 4, 5 6	1.2, 3.5, 4.2 6.6, 7.3, 8.4
8.2						
9.1	150290	Study of Chemical Toxicity of Low-Level Wastes	General Research Corporation	NRC	5, 6	3.1, 3.4, 8.4
9.2	150290	Study of Chemical Toxicity of Low-Level Wastes	General Research Corporation	NRC	5, 6	3.1, 3.4, 8.4
10.1	150250	Risk Methodology for Waste Isolation in Deep Geologic Media	Sandia	NRC	3, 4, 5 6	3.5, 4.3, 6.6 7.2, 8.1
	150291	Definition of Design Performance Criteria for a Radioactive Waste Repository	Analytical Sciences Laboratory	NRC	6, 5	2.1, 6.6, 7.2 8.1
10.2	54069	National Environmental Overview Program	USGS	DOI (USGS)	8, 7, 3	7.2, 2.3, 1.1

APPENDIX B-1

SUMMARY OF ONGOING RESEARCH SUPPORTED BY NON-DOE FEDERAL AGENCIES (FY 1978)

Requirement Number	Identifier Code	Program Title/Description	Performing Organization	Sponsoring Agency	Impact Area	R & D Category
11.1						
11.2	54069	National Environmental Overview Program	USGS	DOI (USGS)	8, 7, 3	7.2, 2.3, 1.1
	150212	GESMO (Generic Environmental Impact Statement for Mixed Oxide Fuel) Waste Management	ANL	NRC	3, 5, 7, 8	5.1, 5.2, 5.5 6.6, 7.1, 7.2, 8.1
	150292	Study to Determine the Country's Waste Disposal Needs Through the Year 2000	Teknekron Incorporated	NRC	3, 7, 8	1.2, 4.2, 5.2 6.1, 7.2
	150327	Updating the Environmental Survey of the Uranium Fuel Cycle	NUS Corp.	NRC	3, 4, 5 6	1.2, 3.5, 4.2 6.6, 7.3, 8.4

APPENDIX B-1

SUMMARY OF ONGOING RESEARCH SUPPORTED BY NON-DOE FEDERAL AGENCIES (FY 1978)

Requirement Number	Identifier Code	Program Title/Description	Performing Organization	Sponsoring Agency	Impact Area	R & D Category
12.1	150326	NRC Waste Management Contractors Conference	Coolfont Re-Creation	NRC	9	7.2, 8.3
12.2	150294	Peer Review of High-level Waste Site Suitability Criteria	TRW	NRC	7, 3, 6 8	5.1, 5.2, 5.3 5.4, 5.5, 6.6 7.2, 8.3
	ORP/CSD-78-2	Proceedings of a Public Forum on Environmental Protection Criteria for Radioactive Wastes	EPA	EPA	3, 4, 8	5.4
12.3	150294	Peer Review of High-Level Waste Site Suitability Criteria	TRW	NRC	7, 3, 6 8	5.1, 5.2, 5.3 5.4, 5.5, 6.6 7.2, 8.3

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number[1]	Identification Code[2]	Program Title/Description	Performing Organization	Impact Area[3]	R & D Category[3]	Comments
1.1	88007	INEL Site Radioecology Program	Health Services Lab, Idaho	1, 4	1.1,4.1	
1.2						
1.3	95103	Waste Immobilization R & D	Multiple Contractors	3	7.2	
	95106	Waste Management R & D	Multiple Contractors	3, 6	7.2	
	L-1	HLW Site Technology	Exxon Nuclear Idaho Company	3, 4 5, 6	2.3 4.3 7.2	Option for immobilization and disposal of/CPP Waste to be recommended in FY-1982
	L-2	Pelletized Calcine	Exxon Nuclear Idaho Company	3, 4 5, 6	2.3 4.3 7.2	Full-scale system is being evaluated

1. Requirement number refers to EH&S requirements given in Table III.1.
2. Code numbers preceded by "L" refer to DOE research programs described at January 16-18, 1980, NRC Information Sessions on Long-Term HLW Technology Program (the "L" numbers have been assigned in the order of program presentation). All other code numbers refer to R & D index numbers used in the Inventory of Federal Energy Related Environment and Safety Research for FY 1978 (in publication).
3. Impact Area and R & D Category numbers are those used in Appendix C, Taxonomy for EDP Concerns and Requirements.

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
1.3 (Cont'd)	L-4	HLW Site Technology	Rockwell Hanford Operations	3, 4 5, 6	2.3 4.3 7.2	Interim report on in-tank storage issued.
	L-5	Alternate Waste Form Assessment	Rockwell Hanford Operations	3, 4 5, 6	2.3 4.3 7.2	Project is in the planning stages. Report on initial assessment to be completed by 7/1/80.
	L-6	Long-term Waste Management Technology	SRL	3, 4 5, 6	2.3 4.3 7.2	Ceramic Melter being installed.
	L-7	Waste Glass Process Development	SRL	3, 4 5, 6	2.3 4.3 7.2	Full-scale continuous melter to be operational by mid CY-1980.
	L-8	Defense Waste Processing Facility (DWPF) -- Design and Liaison	SRL	3, 4 5, 6	2.3 4.3 7.2	Hot start-up schedule for FY 1989.
	L-9	Alternative Waste Forms	SRL	3, 4 5, 6	2.3 4.3 7.2	Report No. DP-1545 issued.

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
1.3 (Cont'd)	L-10	Long-Term HLW Technology	SRL	3, 4 5, 6	2.3 4.3 7.2	Continuing.
	L-11	HLW Immobilization Program	Battelle-PNL	3, 4 5, 6	2.3 4.3 7.2	Continuing.
	L-12	Matrix Development	Battelle-PNL	3, 4 5, 6	2.3 4.3 7.2	Design concepts for glass marble-lead system completed.
	L-13	Coated Particles	Battelle-PNL	3, 4 5, 6	2.3 4.3 7.2	
	L-14	Glass Ceramics	Battelle-PNL	3, 4 5, 6	2.3 4.3 7.2	Literature search under way.
	L-15	Materials Characterization Center	Battelle PNL	3, 4 5, 6	2.3 4.3 7.2	Continuing.

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
1.3 (Cont'd)	L-16	Waste Management Analysis	ORNL	3, 4 5, 6	2.3 4.3 6.3 7.2	Continuing.
	L-17	Fixation of Wastes in Concrete	ORNL	3, 4 5, 6	2.3 4.3 7.2	
	L-18	Study of Ceramic and Cermet Waste Forms	ORNL	3, 4 5, 6	2.3 4.3 7.2	
	L-19	Sol-Gel Technology	ORNL	3, 4 5, 6	2.3 4.3 7.2	
	L-20	High-level Waste Container Development	ORNL	3, 4 5, 6	2.3 4.3 7.2	
	L-21	Coating of High-Level Waste	ORNL	3, 4	2.3 4.3	Not yet funded.

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
1.3 (Cont'd)	L-22	Neutron Activation Analysis/Spike Leaching	ANL	3, 4 5, 6	2.3 4.3 7.2	Tests under way.
	L-27	Mineral Waste Form Development	LLL	3, 4 5, 6	2.3 4.3 7.2	
	L-28	Titanate Ion Exchange	Sandia	3, 4 5, 6	2.3 4.3 7.2	
	L-29	Development of Tailored Ceramics	Rockwell International Penn State University	3, 4 5, 6	2.3 4.3 7.2	Initial test started.
	L-30	Solidification Facility Review	A.D.Little Company	3, 4 5, 6	6.1	
	L-31	Waste Form Deterioration; Review Panel	University of Florida	3, 4 5, 6	2.3 4.3 7.2	2nd meeting in April 1980

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
1.3 (Cont'd)	L-32	Porous Glass Matrix	Catholic University	3, 4 5, 6	2.3 4.3 7.2	Not funded as yet.
	L-33	Synroc Science	NC State University	3, 4 5, 6	2.3 4.3 7.2	Not yet funded.
	L-33	TRU Waste Disassembly and Decontamination	SRL	3, 4 5, 6	2.3 4.3 7.2	Demo by end of FY 80.
	L-35	TRU Waste Incineration	SRP	2, 3, 4 5, 6	2.3 4.3 7.2	Undergoing tests.
2.1	L-1	HLW Site Technology	Exxon Nuclear Idaho Company	3, 4 5, 6	2.3 4.3 7.2	Recommended a specific option for immobilization and disposal/of ICPP/waste/in FY/82.
	L-2	Pelletized Calcine	Exxon Nuclear Idaho Company	3, 4 5, 6	2.3 4.3 7.2	Full-scale system is being evaluated.

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
2.1 (Cont'd)	L-3	Alternate Waste Form Assessment	Exxon Nuclear Idaho Co.	3, 4 5, 6	2.3 4.3 7.2	Literature search under way.
	L-4	HLW Site Technology	Rockwell Hanford Operation	3, 4 5, 6	2.3 4.3 7.2	Interim report on in-tank storage issued.
	L-5	Alternate Waste Form Assessment	Rockwell Hanford Operations	3, 4 5, 6	2.3 4.3 7.2	Project is in the planning stages.
	L-6	Long-Term Waste Management Technology	SRL	3, 4 5, 6	2.3 4.3 7.2	Ceramic melter being installed.
	L-7	Waste Glass Process Development	SRL	3, 4 5, 6	2.3 4.3 7.2	Full-scale continuous melter to be operational by mid CY 1980.
	L-8	Defense Waste Processing Facility (DWPF) Design and Liaison	SRL	3, 4 5, 6	2.3 4.3 7.2	Hot startup scheduled for FY 1989.

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
2.1 (Cont'd)	L-9	Alternative Waste Forms	SRL	3, 4 5, 6	2.3 4.3 7.2	Report No. DP-1545 issued.
	L-10	Long-Term HLW Technology	SRL	3, 4 5, 6	2.3 4.3 7.2	Continuing.
	L-11	HLW Immobilization Program	Battelle-PNL	3, 4 5, 6	2.3 4.3 7.2	Continuing.
	L-12	Matrix Development	Battelle-PNL	3, 4 5, 6	2.3 4.3 7.2	Design concepts for glass marble-lead system completed.
	L-13	Coated Particles	Battelle-PNL	3, 4 5, 6	2.3 4.3 7.2	
	L-14	Glass Ceramics	Battelle-PNL	3, 4 5, 6	2.3 4.3 7.2	Literature search under way.

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
2.1 (Cont'd)	L-15	Materials Characterization Center	Battelle-PNL	3, 4 5, 6	2.3 4.3 7.2	Continuing.
	L-16	Waste Management Analysis	ORNL	3, 4 5, 6	2.3 4.3 6.3 7.2	Continuing
	L-17	Fixation of Wastes in Concrete	ORNL	3, 4 5, 6	2.3 4.3 7.2	
	L-18	Study of Ceramic and Cermet Waste Forms	ORNL	3, 4 5, 6	2.3 4.3 7.2	
	L-19	Sol-Gel Technology	ORNL	3, 4 5, 6	2.3 4.3 7.2	
	L-20	High-Level Waste Container Development	ORNL	3, 4 5, 6	2.3 4.3 7.2	

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
2.1 (Cont'd)	L-21	Coating of High-Level Waste Forms	ORNL	3, 4 5, 6	2.3 4.3 7.2	Not yet funded.
	L-26	Materials Review Board	ANL	8	5.5	Continuing.
	L-27	Mineral Waste Form Development	LLL	3, 4 5, 6	2.3 4.3 7.2	
	L-28	Titanate Ion Exchange	Sandia	3, 4 5, 6	2.3 4.3 7.2	
	L-29	Development of Tailored Ceramics	Rockwell International Penn State University	3, 4 5, 6	2.3 4.3 7.2	Initial test standard
	L-30	Solidification Facility Review	A.D. Little Company	3, 4 5, 6	6.1	

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
2.1 (Cont'd)	L-31	Waste Form Deterioration; Review Panel	University of Florida	3, 4 5, 6	2.3 4.3 7.2	2nd meeting in April 1980.
	L-32	Porous Glass Matrix	Catholic University	3, 4 5, 6	2.3 4.3 7.2	Not funded as yet.
	L-33	SYNROC Science	NC State University	3, 4 5, 6	2.3 4.3 7.2	Not yet funded.
2.2	L-3	Alternate Waste Form Assessment	Exxon Nuclear Idaho Co.	3, 4 5, 6	2.3 4.3 7.2	Literature search under way.
	L-5	Alternate Waste Form Assessment	Rockwell Hanford Operations	3, 4 5, 6	2.3 4.3 7.2	Project is in the planning stages.

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
2.2 (Cont'd)	L-24	Metal Matrix	ANL	3, 4 5, 6	2.3 4.3 7.2	
	L-25	SYNROC Science	ANL	3, 4 5, 6	2.3 4.3 7.2	
	L-29	Development of Tailored Ceramics	Rockwell International Penn State University	3, 4 5, 6	2.3 4.3 7.2	Initial test started.
2.3	85159	Environmental Policy Analysis	ORNL	7	5.1 5.2 5.3	
	L-6	Long-term Waste Management Technology	SRL	3, 4 5, 6	2.3 4.3 7.2	Ceramic melter being installed.
	L-35	TRU Waste Incineration	SRP	2, 3 4, 6 6	2.3 4.3 7.2	Undergoing tests.

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
3.1						
4.1						
5.1.1	95102	Commercial Nuclear Waste Management - Terminal Storage R & D	Battelle - Columbus	3	7.2	
	95108	Defense Radioactive Waste Management R & D	Multiple Contractors	3	7.2	
	L-22	Neutron Activation Analysis/Spike Leaching	ANL	3, 4 5, 6	2.3 4.3 7.2	Tests under way.

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
5.1.2	95102	Commercial Nuclear Waste Management - Terminal Storage R & D	Battelle - Columbus	3	7.2	
5.1.3	95102	Commercial Nuclear Waste Management - Terminal Storage R & D	Battelle - Columbus	3	7.2	
5.1.4						
5.1.5						
5.1.6	85159	Environmental Policy Analysis	ORNL	7	5.1 5.2 5.3	
	95102	Commercial Nuclear Waste Management - Terminal Storage R & D	Battelle - Columbus	3	7.2	

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
5.1.7						
6.1						
6.2	86110	Analysis of Nuclear Fuel Cycles	Battelle-PNL	3	7.1	
	L-23	Brittle Fracture Study	ANL	3, 4 5, 6	2.3 4.3 7.2	Tests under way.
6.3						
6.4	L-1	HLW Site Technology	Exxon Nuclear Idaho Co.	3, 4 5, 6	2.3 4.3 7.2	

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
6.4 (Cont'd)	L-2	Pelletized Calcine	Exxon Nuclear Idaho Co.	3, 4 5, 6	2.3 4.3 7.2	Full-scale system is being evaluated.
	L-4	HLW Site Technology	Rockwell Hanford Operations	3, 4 5, 6	2.3 4.3 7.2	Interim report on in-tank storage issued.
	L-5	Alternate Waste Form Assessment	Rockwell Hanford Operations	3, 4 5, 6	2.3 4.3 7.2	Project is in the planning stages. Report on initial assessment to be completed by 7/1/80.
	L-6	Long-term Waste Management Technology	SRL	3, 4 5, 6	2.3 4.3 7.2	Ceramic melter being installed.
	L-7	Waste Glass Process Development	SRL	3, 4 5, 6	2.3 4.3 7.2	Full-scale continuous melter to be operational in mid CY 1980.
	L-8	Defense Waste Processing Facility (DWPF) -- Design and Liaison	SRL	3, 4 5, 6	2.3 4.3 7.2	Hot startup scheduled for FY 89.

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
6.4 (Cont'd)	L-9	Alternative Waste Forms	SRL	3, 4 5, 6	2.3 4.3 7.2	Report No. DP-1545 issued.
	L-10	Long-term HLW Technology	SRL	3, 4 5, 6	2.3 4.3 7.2	Continuing.
	L-11	HLW Immobilization Program	Battelle-PNL	3, 4 5, 6	2.3 4.3 7.2	Continuing.
	L-12	Matrix Development	Battelle-PNL	3, 4 5, 6	2.3 4.3 7.2	Design concepts for glass marble-lead system completed.
	L-13	Coated Particles	Battelle-PNL	3, 4 5, 6	2.3 4.3 7.2	
	L-14	Glass Ceramics	Battelle-PNL	3, 4 5, 6	2.3 4.3 7.2	Literature search under way.

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
6.4 (Cont'd)	L-15	Materials Characterization Center	Battelle-PNL	3, 4 5, 6	2.3 4.3 7.2	Continuing
	L-16	Waste Management Analysis	ORNL		2.3 4.3 6.3 7.2	Continuing
	L-17	Fixation of Wastes in Concrete	ORNL	3, 4 5, 6	2.3 4.3 7.2	
	L-18	Study of Ceramic and Cermet Waste Forms	ORNL	3, 4 5, 6	2.3 4.3 7.2	
	L-19	Sol-Gel Technology	ORNL	3, 4 5, 6	2.3 4.3 7.2	
	L-20	High-Level Waste Container Development	ORNL	3, 4 5, 6	2.3 4.3 7.2	

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
6.4 (Cont'd)	L-21	Coating of High-Level Waste Forms	ORNL	3, 4 5, 6	2.3 4.3 7.2	Not yet funded.
	L-27	Mineral Waste Form Development	LLL	3, 4 5, 6	2.3 4.3 7.2	
	L-28	Titanate Ion Exchange	Sandia	3, 4 5, 6	2.3 4.3 7.2	
	L-29	Development of Tailored Ceramics	Rockwell International Penn State University	3, 4 5, 6	2.3 4.3 7.2	Initial test started.
	L-30	Solidification Facility Review	A.D. Little Company	3, 4 5, 6	6.1	
	L-31	Waste Form Deterioration; Review Panel	University of Florida	3, 4 5, 6	2.3 4.3 7.2	2nd meeting in April 1980.

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
6.4 (Cont'd)	L-32	Porous Glass Matrix	Catholic University	3, 4 5, 6	2.3 4.3 7.2	Not funded as yet.
	L-33	SYNROC Science	NC State University	3, 4 5, 6	2.3 4.3 7.2	Not yet funded.
	L-35	TRU Waste Incineration	SRP	2, 3 4, 5 6	2.3 4.3 7.2	Undergoing tests.
7.1	86110	Analysis of Nuclear Fuel Cycles	Battelle-PNL	3	7.1	
	88007	INEL Site Radioecology Program	Health Services Lab. Idaho	1, 4	1.1,4.1	
	95211	Waste Management Information Support	ORNL	3, 5	7.2	

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
7.2	86041	Radioecology of Nuclear Fuel Cycles	Battelle-PNL	4	4.2	
	88007	INEL Site Radioecology Program	Health Services Lab. Idaho	1, 4	1.1,4.1	
	95211	Waste Management Information Support	ORNL	3, 5	7.2	
7.3	L-34	TRU Waste Disassembly and Decontamination	SRL	3, 4 5, 6	2.3 4.3 7.2	Demo by end of FY 80.
8.1	88007	INEL Site Radioecology Program	Health Services Lab. Idaho	1, 4	1.1,4.1	
	95102	Waste Immobilization R & D	Multiple Contractors	3	7.2	

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
8.1 (Cont'd)	95104	Gaseous and Airborne Waste R & D	Multiple Contractors	1	7.2	
	95107	Defense Airborne Radioactive Waste R & D	Multiple Contractors			
8.2						
9.1						
9.2						
10.1						

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
10.2	85041	Radioecology of Nuclear Fuel Cycles	Battelle-PNL	4	4.2	
	88007	INEL Site Radioecology Program	Health Services Lab. Idaho	1, 4	1.1,4.1	
11.1						
11.2	85159	Environmental Policy Analysis	ORNL	7	5.1,5.2 5.3	
12.1						

APPENDIX B-2

SUMMARY OF RESEARCH SUPPORTED BY THE DEPARTMENT OF ENERGY (FY '79, '80)

Requirement Number	Identification Code	Program Title/Description	Performing Organization	Impact Area	R & D Category	Comments
12.2						
12.3						
12.4						
12.5						

APPENDIX B-3

SUMMARY OF RESEARCH SUPPORTED BY OTHER COUNTRIES

Requirement Number*	Ongoing Research and Development Projects and Other Studies	Responsible Country	Comment
1.1		—	
1.2			
1.3	Wet combustion of solid wastes containing plutonium.	Federal Republic of Germany	Investigation of the kinetics of waste treatment and of separation of residues from acid solutions.
	Volume reduction of aqueous wastes at AECL by reverse osmosis.	Canada	Reverse osmosis is being assessed as a means of reducing the volume of low level aqueous wastes prior to solidification.
2.1	Evaluation of characteristics of solidified radioactive wastes.	Italy	Evaluation of characteristics of solidified wastes including leachability, radiation stability, mechanical strength, flammability, and heat resistance and weathering.
2.2	Radiolysis Gases From Mixtures of Bitumen with Sodium Nitrate and with ion-exchange resins.	Federal Republic of Germany	Investigation of radiolysis gases from bituminized low and medium level radioactive wastes.
	Studies of the effects of high level radioactive waste disposal in the deep ocean.	United Kingdom	Study of the dispersion of radioactivity in the deep ocean arising from the possible dumping of high level waste on the sea floor, suitably contained to permit slow leaching over a long time scale.

* Requirement number refers to EH&S requirements given in Table III-1.

APPENDIX B-3

SUMMARY OF RESEARCH SUPPORTED BY OTHER COUNTRIES

Requirement Number	Ongoing Research and Development Projects and Other Studies	Responsible Country	Comment
2.3			
3.1	Transuranic elements in the Marine Environment.	United Kingdom	Research into the environmental behavior of plutonium and americium continues including study of plutonium in sediments, their distribution in all interstitial water as well as down the sediment column.
	Maximum Vertical Displacement of the Sea Level in the Area of Taranto during the last 120,000 years from the geological point of view to study radioactive wastes containing transuranium elements.	Italy	Dating of samples to demonstrate sea level displacement as a contribution to the estimation of the "maximum geological change reasonably foreseeable."
	Watermass transport investigations in the North Sea.	Federal Republic of Germany	The radiological North Sea Programme has been completed and includes data on Cs, Pu, Am, ^{3}H and Ru. The pursuit of the temporal course of the spreading of the waste waters introduced into the sea near Windscale and Cherbourg should provide better knowledge of watermass transport, and transportation times in the North Sea.
4.1			

APPENDIX B-3

SUMMARY OF RESEARCH SUPPORTED BY OTHER COUNTRIES

Requirement Number	Ongoing Research and Development Projects and Other Studies	Responsible Country	Comment
5.1.1	Maximum Vertical Displacement of the Sea Level in the Area of Taranto during the last 120,000 years from the geological point of view to study radioactive wastes containing tranuranium elements.	Italy	Dating of samples to demonstrate sea level displacement as a contribution to the estimation of the "maximum geological change reasonably foreseeable."
	Specifications for the final disposal.	Austria	Definition of the specifications for the final disposal of the predicted wastes to be generated was done using the method of fault tree analysis.
	Maximum vertical displacement of the sea level in the area of Taranto during the last 120,000 years from the geologic point of view to study radioactive wastes containing transuranium elements.	Italy	Dating of samples to demonstrate sea level displacement as a contribution to the estimation of the "maximum geologic change reasonably foreseeable."
5.1.2	Development of a three dimensional transient heat conduction code for studies on the heating of rock salt by solidified high level wastes.	Federal Republic of Germany	A computer program was developed to take into account all the important effects in a thermal analysis of a waste repository in a salt formation.
5.1.3	Thermal behavior of granite.	Austria	For the use of granite formations for the final disposal of solidified high level waste the interactions of phosphate and borosilicate glasses with granite, the thermal behavior of granite, and the stability of granite under the influence of irradiation and the heat production of waste is investigated.

APPENDIX B-3

SUMMARY OF RESEARCH SUPPORTED BY OTHER COUNTRIES

Requirement Number	Ongoing Research and Development Projects and Other Studies	Responsible Country	Comment
5.1.4	Transuranic elements in the Marine Environment.	United Kingdom	Research into the environmental behavior of plutonium and americium continues including study of plutonium in sediments, their distribution in the interstitial water as well as down the sediment column.
	Contaminant Hydrogeochemistry	Canada	Includes chemical analyses of ground water, studies of soil sorption of ^{90}Sr and ^{137}Cs mapping of soil radioactivity plumes from 1954-55 experimental waste disposals, study of physical contaminant transport parameters (by convection and dispersion), studies of sorption processes at work, summary of hydrologic characteristics of the northeast side of Perch Lake basin and evapotranspiration calculations based on ground water level fluctuations.
5.1.5			
5.1.6			
5.1.7			
6.1			

APPENDIX B-3

SUMMARY OF RESEARCH SUPPORTED BY OTHER COUNTRIES

Requirement Number	Ongoing Research and Development Projects and Other Studies	Responsible Country	Comment
6.2			
6.3	Oceanographic modelling for calculating the limiting capacity of the oceans to accept radio-active waste.	United Kingdom	Development of a revised oceanographic model for use to provide a conservative estimate of maximum concentrations of radioactivity in water as a function of time after start of a continuous disposal operation. These results can then be used to assess the limiting capacity of an ocean to accept radioactive waste.
7.1	Contaminant Hydrogeochemistry	Canada	Includes chemical analyses of ground water, studies of soil sorption of ^{90}Sr and ^{137}Cs, mapping of soil radioactivity plumes from 1954-55 experimental waste disposals, study of physical contaminant transport parameters (by convection and dispersion), studies of sorption processes at work, summary of hydrologic characteristics of the northeast side of Perch Lake basin and evapotranspiration calculations based on ground water level fluctuations.

APPENDIX B-3

SUMMARY OF RESEARCH SUPPORTED BY OTHER COUNTRIES

Requirement Number	Ongoing Research and Development Projects and Other Studies	Responsible Country	Comment
7.1 (Cont'd)	Radiological Protection Aspects of Disposal of High Level Waste on the Ocean Floor.	United Kingdom	A preliminary assessment of the potential radiological consequences of disposal of solidified high level waste on the bed of the deep ocean has been carried out. It includes modelling of release of activity into the water, its dispersion in the ocean and eventual uptake by marine organisms and sediment. The consequent radiation exposure of man is assessed in terms of both individual and collective doses.
	Biogeochemistry of the Waste Management Area.	Canada	A program to examine oxidation reduction processes in groundwater flow systems.
7.2			
7.3	Treatment of spent ion-exchange resins.	Federal Republic of Germany	Ion-exchange resins from reactor-stations are normally extensively contaminated. Immobilization is normally done by bituminization or cementation with the disadvantage of volume increase. Investigations were performed to convert the resins by combustion into a small volume of mineral ash.
	Bituminization of radioactive wastes.	Canada	Bituminization of low level wastes such as incinerator ash, ion-exchange resin, and aqueous concentrates to create a stable leach-resistant waste form for final disposal using a twin screw extruder-evaporator and a thin-film evaporator.

APPENDIX B-3

SUMMARY OF RESEARCH SUPPORTED BY OTHER COUNTRIES

Requirement Number	Ongoing Research and Development Projects and Other Studies	Responsible Country	Comment
7.3 (Cont'd)	Radiolysis gases from mixtures of Bitumen with sodium nitrate and with ion-exchange resins.	Federal Republic of Germany	Investigation of radiolysis gases from bitumized low and medium level radioactive wastes.
	Experiments on the treatment and solidification of low and intermediate level liquid radwastes by non-boiling evaporation.	Hungary	By means of this method liquid wastes may be concentrated up to practically dry phase. The process essentailly consists of evaporating the wastes fed into a tank by circulating an eddying flow of hot air through the airspace of the tank in a closed circuit, which evaporates the liquid below its boiling point.
	Conditioning of low and medium level wastes.	Austria	To reduce gaseous effluents from incineration different materials are used to absorb different organic liquids containing ^3H and ^{14}C. The resulting sludges are solidified with cement. Ion-exchange resins are decomposed in aqueous solutions to an extent sufficient to assure no further gas production by radiation damage and the resultant solutions solidified with cement.
	Technique for converting spent ion-exchange resins into a stable and safely storable form.	Austria	An improved heat treatment is developed for converting the resin into a form that can be safely stored, either directly or embedded in bitumen or concrete.
	Incineration of low level reactor wastes.	Canada	A starved-air type incinerator is being developed to reduce the volume of wastes and convert them to a form suitable for immobilization in bitumen.

APPENDIX B-3

SUMMARY OF RESEARCH SUPPORTED BY OTHER COUNTRIES

Requirement Number	Ongoing Research and Development Projects and Other Studies	Responsible Country	Comment
7.3 (Cont'd)	Bituminization of radioactive wastes by sedimentation technique.	Federal Republic of Germany.	Treatment of low to medium level liquid waste concentrates by drying and subsequent mixing of the residues with bitumen without mechanical aids - only by gravity.
	Volume reduction of aqueous wastes by reverse osmosis.	Canada	Reverse osmosis is being assessed as a means of reducing the volume of low level aqueous wastes prior to solidification.
	Incorporation of radioactive waste in polymer impregnated cement.	Italy	Polymer-impregnated cement (PIC) has been examined from a technical viewpoint as a possible medium for immobilization of low and intermediate wastes. A demonstration pilot plant for the incorporation of radioactive chemical sludges in PIC has been designated and under construction.
	Experiments on the treatment and solidification of low and intermediate level liquid radwastes by non-boiling evaporation.	Hungary	By means of this method liquid wastes may be concentrated up to practically dry phase. The process essentailly consists of evaporating the wastes, fed into a tank, by circulating an eddying flow of hot air through the air space of the tank in a closed circuit which evaporates the liquid below the boiling point.
	Treatment of aqueous waste by reverse osmosis.	Australia	Pilot scale study to investigate the use of reverse osmosis to concentrate dilute aqueous wastes. The process allows a more efficient decontamination of the concentrate and discharge or recycle of the product wafer.

APPENDIX B-3

SUMMARY OF RESEARCH SUPPORTED BY OTHER COUNTRIES

Requirement Number	Ongoing Research and Development Projects and Other Studies	Responsible Country	Comment
7.3 (Cont'd)	Evaporation Plant for low and medium level liquid wastes.	Austria	Contrary to the single-stage evaporation plants with decontamination factors (DF) of about 10^6 for non-volatile matter, a two stage process was developed and studied in the Research Center Seibersdorf. The first commercial unit with a capacity of $2m^3/h$ yielded a DF of 10^9 at nominal throughput and of better than 10^8 at 40% overload.
	Studies on the Bituminization of Radioactive Liquid Waste	Republic of Korea	The effects of temperature and pressure of leaching water on the leaching of radionuclides from bitumen waste products were studied. Comparison of sea and distilled water leaching rates and the effect of the softening point of pure asphalt or bitumen waste product by ^{60}Cobalt irradiation were also studied.
8.1	Conditioning of low and medium level wastes.	Austria	To reduce gaseous effluents from incineration, different materials are used to absorb different organic liquids containing ^3H and ^{14}C. The resulting sludges are solidified with cement. Ion exchange resins are decomposed in aqueous solutions to an extent sufficient to assure no further gas production by radiation damage and the resultant solutions solidified with cement.
8.2			
9.1			

APPENDIX B-3

SUMMARY OF RESEARCH SUPPORTED BY OTHER COUNTRIES

Requirement Number	Ongoing Research and Development Projects and Other Studies	Responsible Country	Comment
9.2			
10.1			
10.2			
11.1			
11.2			
12.1			
12.2			
12.3			
12.4			
12.5			

Appendix C

TAXONOMY FOR EDP CONCERNS AND REQUIREMENTS TABLE

CATEGORY A

LIST OF ENVIRONMENTAL, HEALTH AND SAFETY IMPACT AREAS

1. Air Quality
2. Water Quality
3. Solid Waste
4. Ecology
5. Health
6. Safety
7. Socioeconomic Factors
8. Resources, including land
9. Other

CATEGORY B

LIST OF ENVIRONMENTAL, HEALTH AND SAFETY RESEARCH AREAS

1. Characterization, Measurement, and Monitoring
    - 1.1 Baseline Inventory on Concentration and Distribution of Pollutants
    - 1.2 Source Term Characterization
    - 1.3 Measurement Technology
    - 1.4 Monitoring
2. Physical and Chemical Effects
    - 2.1 Environmental Transport, Dispersion, and Diffusion of Pollutants
    - 2.2 Transformation of Pollutants
    - 2.3 Physical and Chemical Disturbances
3. Health Effects
    - 3.1 Screening for Hazardous Agents
    - 3.2 Metabolism and Fate
    - 3.3 Dose Effect Toxicity Data
    - 3.4 Human Health Effects
    - 3.5 Health Effects Assessments

4. Ecological Effects
   - 4.1 Baseline Ecological Studies
   - 4.2 Hazardous Materials and Effects Mechanisms
   - 4.3 Physical and Chemical Effects
   - 4.4 Ecological Cycling of Pollutants to Man

5. Socioeconomic Effects
   - 5.1 Social
   - 5.2 Economic
   - 5.3 Political
   - 5.4 Institutional
   - 5.5 Resource Utilization

6. Environmental Evaluations
   - 6.1 Technology Assessments
   - 6.2 Environmental Readiness Documents
   - 6.3 Cost/Risk Benefit Studies
   - 6.4 NEPA Environmental Assessment
   - 6.5 NEPA Environmental Impact Statement
   - 6.6 Other Environmental Evaluations

7. Environmental Control Technology (ECT) Development
   - 7.1 Identification and Evaluation of Alternative ECT Options and Development of Pollution Controls
   - 7.2 Containment, Storage, and Disposal Technology
   - 7.3 Reclamation and Decontamination

8. Occupational and General Safety
   - 8.1 Safety Assessments and Analysis
   - 8.2 Quality Control and Assurance
   - 8.3 Criteria, Guidelines, and Standards
   - 8.4 Dose Assessment, Measurement, and Monitoring
   - 8.5 Record-Keeping and Protocol Development

Appendix D

ENVIRONMENTAL, HEALTH AND SAFETY DOCUMENTATION

Environmental Readiness Document (ERD)

The ERD is an assessment report prepared by the ASEV with full cognizance of technology program line managers. It provides a state-of-the-art assessment of the environmental status of a technology at the phase of development being considered for management decisions, usually at the key decision points of the Management System. The ERD presents the results of a critical review and scholarly analysis of environmental R&D results carried on in the preceding phase and provides further definition of concerns and research needs for the ensuing period. The ERD provides the basis for the ASEV position on the environmental readiness of a DOE technology at each key decision point.

Environmental Assessment (EA)/Environmental Impact Statement (EIS)

The National Environmental Policy Act of 1969 requires that agencies prepare Environmental Impact Statements "on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment." An Environmental Assessment is a brief document that provides the information on which to base a determination of the necessity for an Environmental Impact Statement or a Finding of No Significant Impact (FONSI). Environmental Assessments may be prepared for any action and at any time in order to assist Departmental planning and decisionmaking. EA's and EIS's are prepared by program offices according to DOE procedures and approved by the Office of Environment after consultation with the Office of the General Counsel.

Safety Analyses

A safety analysis is prepared by program managers according to DOE procedures, Safety Analyses Review System (SARS) DOE Order 5480.1, early in the design phase of a proposed facility that DOE intends to procure and operate. The use of a safety analysis to identify hazards, eliminate and control identified hazards, assess residual risk, and document management authorization of a DOE operation applies equally to technology base activities and energy system acquisition projects. The purpose is to limit risks to health and safety of the public and employees and adequately protect property and the environment. The safety analysis preparation and review process ensures that:

- Potential hazards are systematically identified.
- Potential impacts are accurately analyzed.
- All reasonable measures to eliminate, control, or mitigate the hazards have been taken.
- There is documented management authorization of the DOE operation based upon an objective assessment of the residual risk identified in the safety analysis.

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